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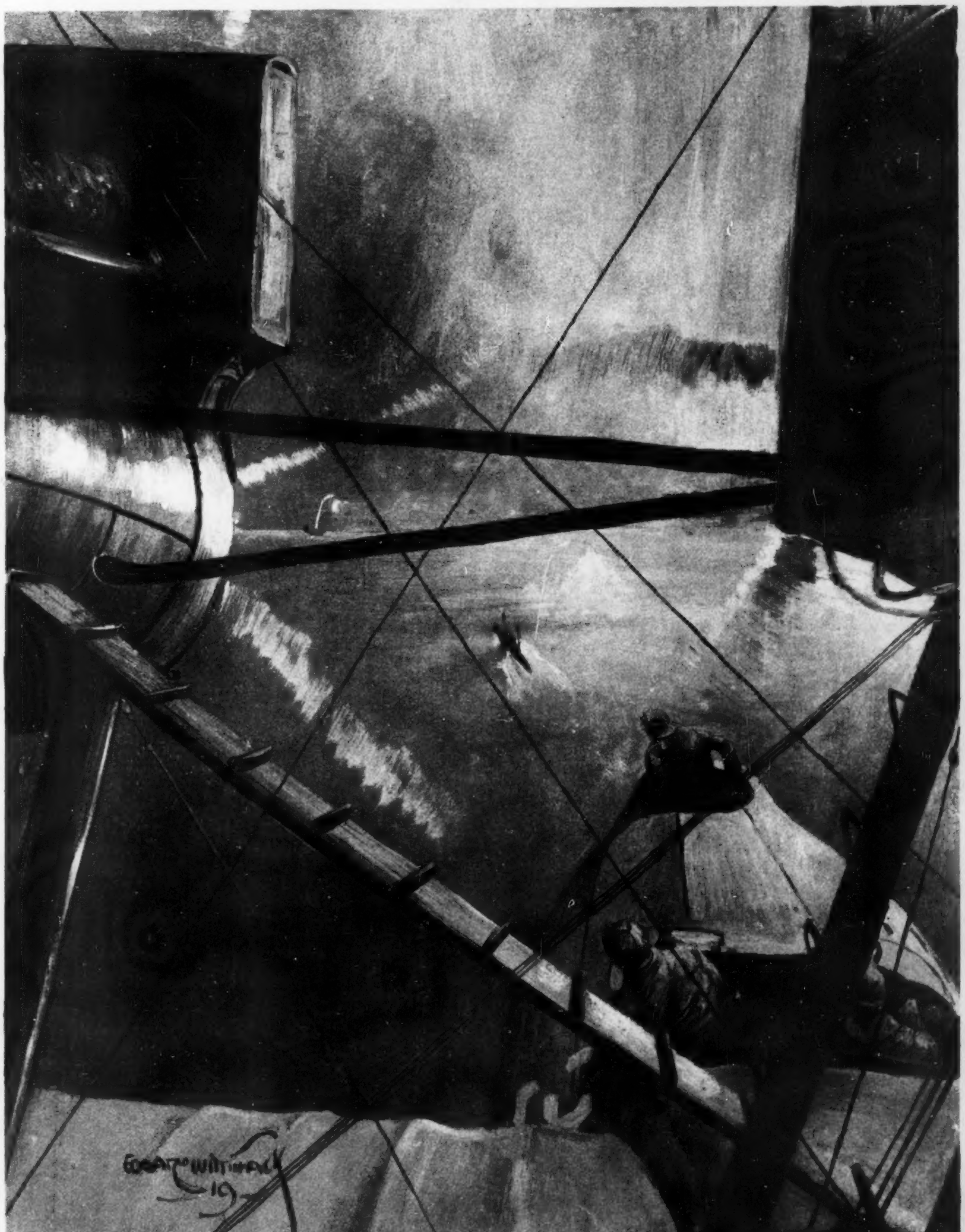

ABOVE THE MID-ATLANTIC IN ONE OF THE N. C. FLYING BOATS

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May 17, 1919

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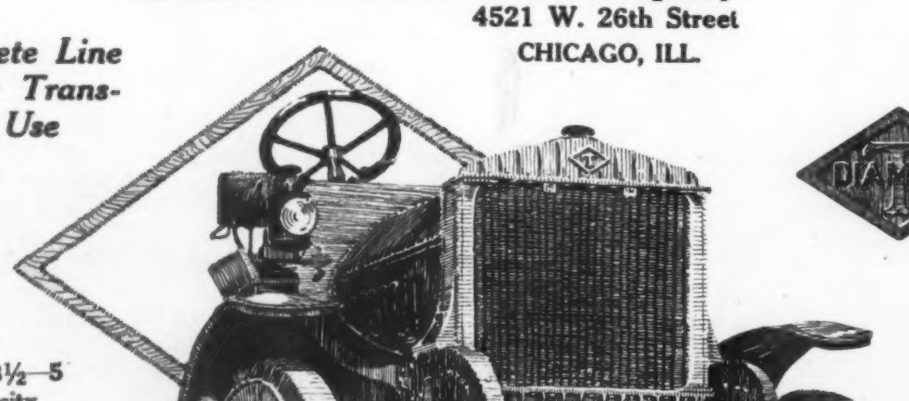

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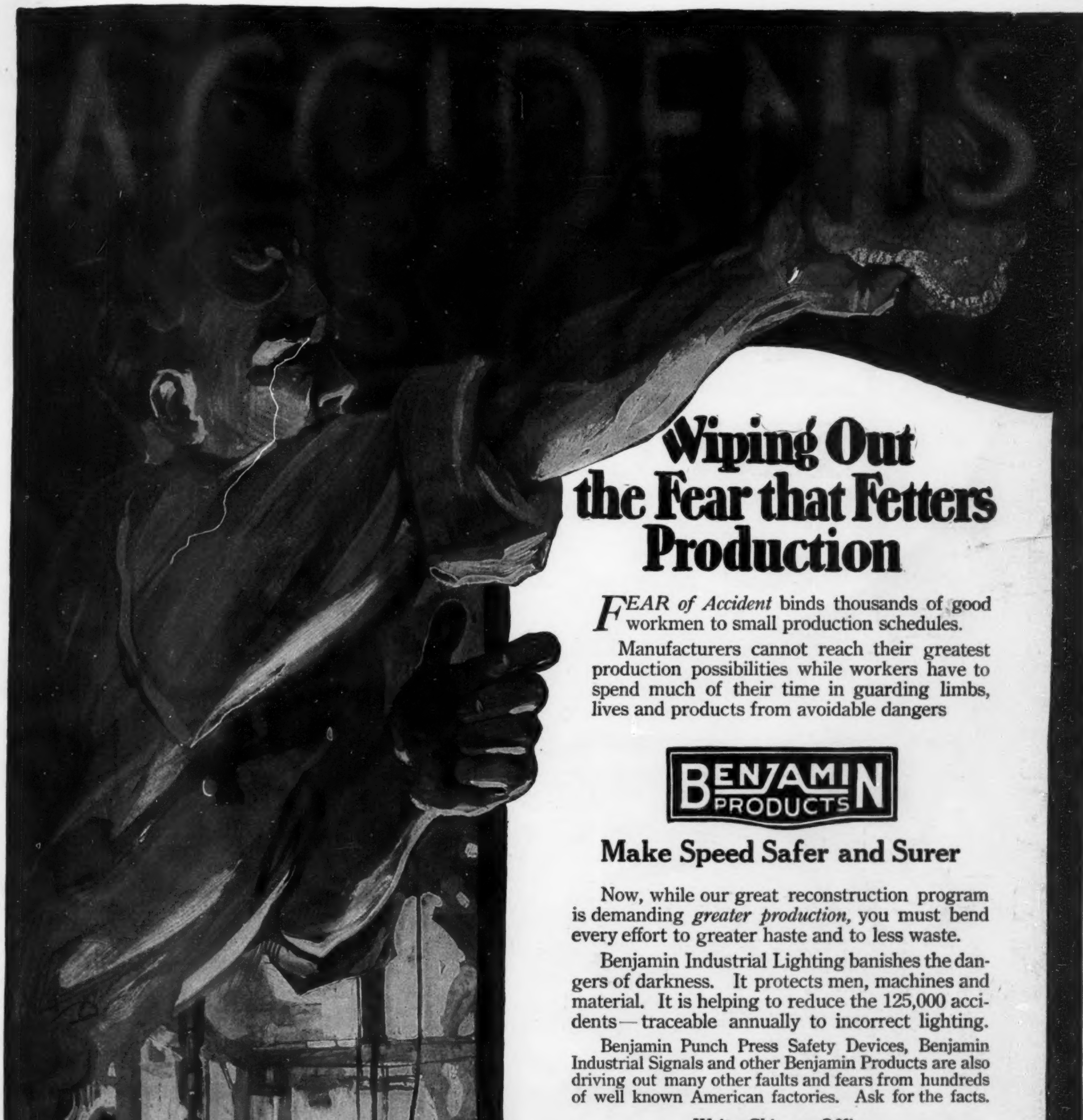
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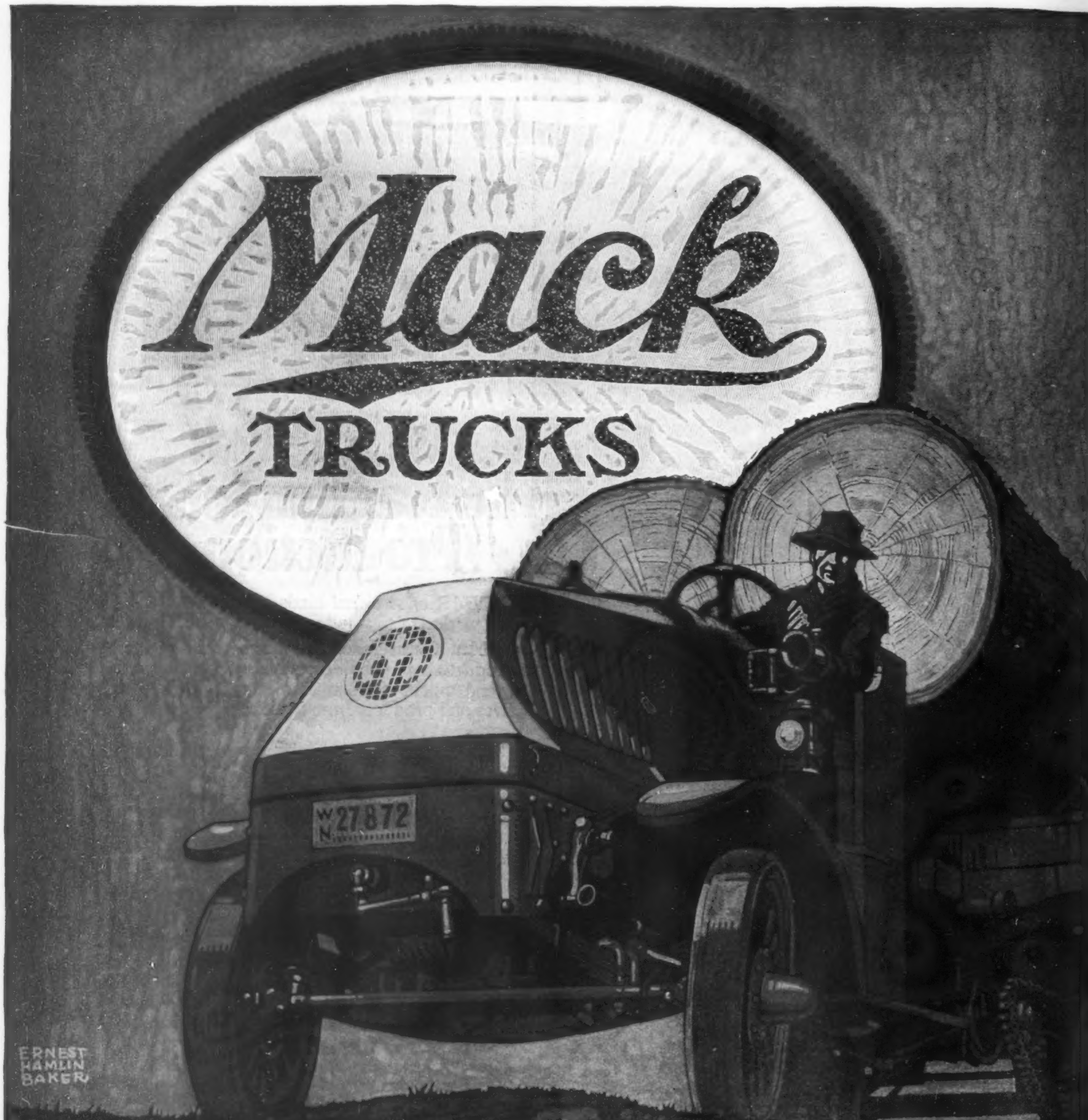
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SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

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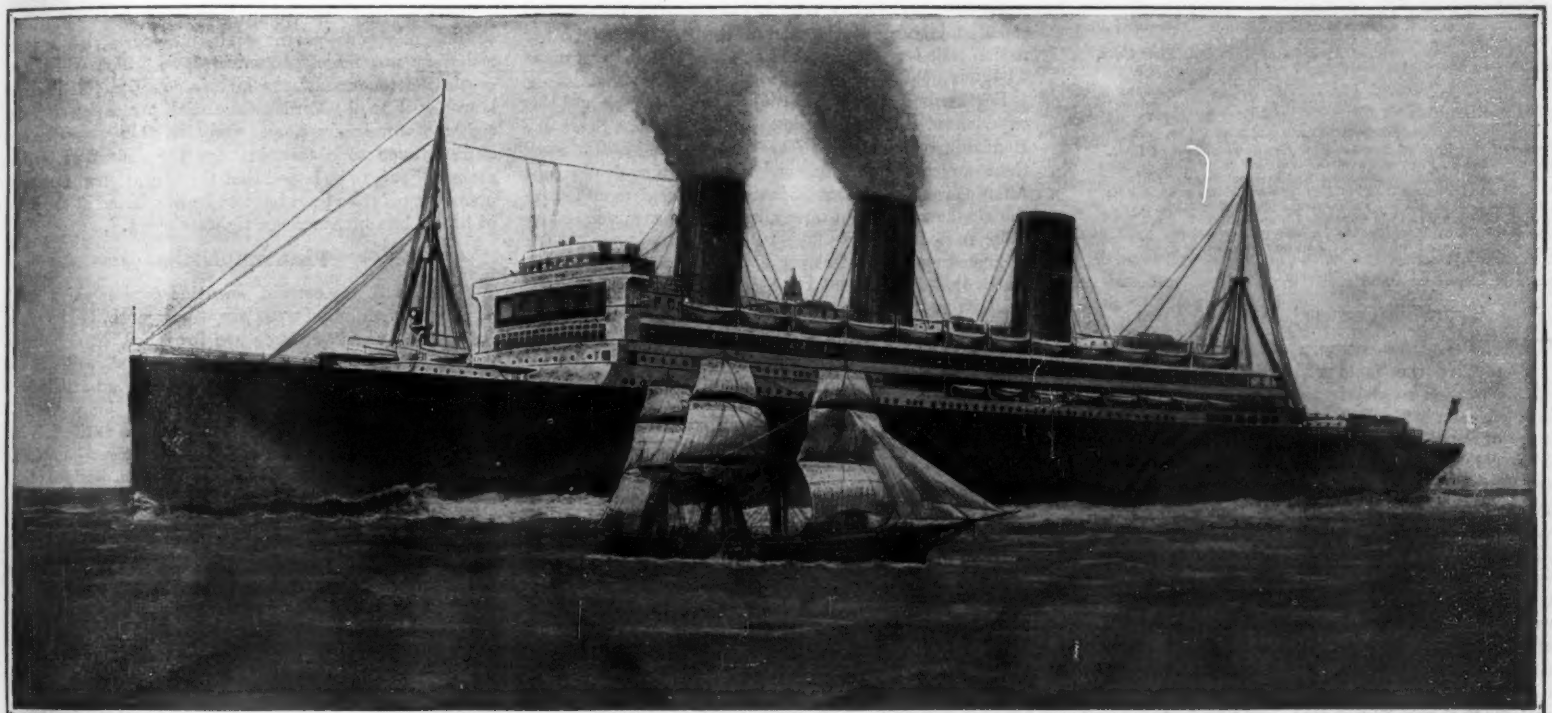

The first vessel to use steam in crossing the Atlantic, contrasted with one of the typical ocean giants of today

The Pioneer of the Trans-Atlantic Liner

By Robert G. Skerrett

WHILE the blue ribbon of trans-Atlantic passenger service has long been held by vessels of other flags, credit, nevertheless, for blazing the way for steam navigation between the United States and Europe belongs to America. One hundred years ago, on the 24th of May, the steamer "Savannah" cleared Tybee, Ga., and started upon her memorable voyage to Liverpool. It was the ambition of her owners to establish a fast line between the port of Savannah and England, and by qualifying reliance upon the changeful winds, to make it practicable, through the agency of steam machinery, to forge steadily onward despite calms or opposing gales.

That radically ambitious scheme was the outcome of the steadily widening scope of our domestic steamboats which traversed the land-locked reaches of our rivers or the sheltered waters of some of our lakes and sounds. It was also promoted by the local pride of certain Savannah shipowners, Messrs. Scarborough and Isaacs, who believed that, through the adoption of steam, they might outstrip New York in the field of foreign trade. The man directly responsible for this courageous venture was Capt. Moses Rogers, a Connecticut mariner of repute, who had become familiar with the engine afloat by association with the steamboat undertakings of Robert Fulton and John Stevens. He it was who induced the Savannah shipowners to buy the vessel when she was nearly ready for launching and to fit her with auxiliary power.

The "Savannah" was built in New York at the yard of Crocker and Fickett, and was planned to be a full-rigged ship. This part of her was unchanged with the exception of stepping her mainmast somewhat farther aft in order to provide space amidships for the installing of the boilers and engine and for the stowage of coal. The fueling arrangments were for 75 tons of coal and 25 cords of kindling wood. It was believed that these would suffice to carry the vessel across the Atlantic, and evidenced how little general information was available a century ago concerning coal consumption. In fact, as late as 1834, data furnished by McGregor Laird, the founder of the famous Birkenhead firm, informed a committee of the House of Commons that engines of less than 120-horse-power would require 10.5 pounds of coal per horse-power per hour. At that rate, the "Savannah" should have had a steaming radius of about 175 hours or a little more than seven days; but she fell a good deal short of this.

The "Savannah's" engine, built by Stephen Vail at the Speedwell Iron Works, near Morristown, N. J., was rated at 90 horse-power and was of the inclined, direct-acting, low-pressure type, with a cylinder having a diameter of 40 inches and a stroke of five feet. The principal stumbling block to outfitting the craft was the boilers of which she carried two. Those actually placed in the vessel were constructed by Dåniel Dod of Elizabeth, N. J., and were not accepted until after several others had been rejected. Contemporaneous reports specify that the steam generators were to work at full head under a pressure of 20 inches of steam as determined by a mercury gage.

While the log of the "Savannah" nowhere tells how fast she was able to run under her engine alone, it was reported in one of the New York papers in the latter part of March of 1819 that, during a steam trial in that port, she covered a total distance of 10 miles, both with and against the tides in an interval of 1 hour and 50 minutes. On the other hand, the ship when eight days out from Savannah and bound for Liverpool was spoken by a sailing vessel, which reported that the steamer at that time was making between nine and 10 knots an hour—she was probably using both steam and sail.

On the 28th of March, 1819, the "Savannah" left New York for Savannah, and after a stop at Charleston, S. C., she reached her destination on the 6th of April. During her trip southward she was under steam for a total period of 41½ hours—her longest interval of continuous steaming being 17 hours. Shortly after leaving Sandy Hook behind the wind became somewhat fresh, and it was found advisable to unship her paddle-wheels. These wheels were so arranged that they could be folded up like a fan and stowed upon deck when the sea was too rough for their employment. The operation of getting them over the sides or taking them inboard required something like half an hour.

The "Savannah" was intended to carry both freight and passengers. For the accommodation of the latter, her cabin space was divided into three saloons, and these were "handsomely furnished with imported carpets, curtains, and hangings, and were decorated with mirrors." She boasted in all of 32 berths, each of which was a stateroom, that arrangement being something of a departure in passenger ships.

The "Savannah" remained at Savannah for some weeks, attracting a great deal of attention the while and being visited by President Monroe, who encouraged the belief that the government would ultimately buy her and equip her as a naval vessel. On the 22d of May, 1819, the ship dropped down off Tybee, but owing to unfavorable weather conditions she did not put to sea until two days later. Then, with steam up, she headed boldly into the Atlantic and straightened out upon the northern course which was to carry her across to Liverpool. Her log, which is in the U. S. National Museum, gives the following particulars of her periods of steaming during her voyage to Europe:

	Hours
May 30th, 8 A. M. to 6 P. M.	10
June 1st, 8 A. M. to June 2d, 2 A. M.	18
June 6th, 8 A. M. to 12 P. M.	16
June 9th, 8 A. M. to 12 Noon	4
June 11th, 10 A. M. to 12 P. M.	14
June 16th, 8 P. M. to June 17th, 2 P. M.	18
Total hours of steaming	80

(Continued on page 520)

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The Ship-Owners' Point of View

THERE are some men who have the faculty of stating the facts of a seemingly complicated situation so clearly that he who runs may read. One such man is Mr. Robert Dollar, an experienced ship-owner of San Francisco, who recently made an analysis of the shipping situation which should be in the hands of everyone who is interested in upbuilding our merchant marine—which means that it should be in the hands of every citizen of the United States.

He begins by giving a diagram showing the percentage of American goods carried in American ships since the Republic was founded, from which we learn that in 1789 twenty-three and eight-tenths per cent of our trade was carried in American ships, and that during the period of the preferential duties, the percentage rose in 1795 to 90 per cent, and maintained about that figure until 1830, when it was 89 per cent. The preferential duties ceased in 1830 and by 1840 the percentage fell to 72.5 per cent; by 1860 to 66.2; and then, due largely to the Civil War, fell to 35.6 by 1870; to 17.4 by 1880; and in the first half of 1914 up to the Great War, it was only 0.97 per cent.

As to conditions on the Pacific Ocean, with which Mr. Dollar is particularly familiar, we are told that in 1913 "before the Seamen's Bill had gotten in its deadly work," Japanese vessels in the American trade in the Pacific were 26.05 per cent and American vessels were 26.10 per cent, but after May 1st, 1917, Japanese vessels were 50.90 per cent and American vessels, as the direct result of the action of the Seamen's Bill, dropped to 1.97 per cent.

Although it is well understood that the war has lifted the scale of seamen's wages among the foreign nations, it is pertinent to take note of Mr. Dollar's figures for three of his own steamers which were operating in 1914. Their indicated horse-power was exactly the same and their tonnage nearly the same. One of these was an American steamer employing 47 men at \$3,720 per month; another was a British steamer employing 36 men at the cost for wages of \$1,308 per month; and the third was a Japanese steamer employing 36 men at a cost for wages of \$777 per month.

Another question of importance referred to by Mr. Dollar is that of the measurement of ships, regarding which he claims that there should be a change in our laws. He takes the standard steamers of 8,800 tons deadweight, of the kind which is being built in such numbers for the Shipping Board, and compares them with his own steamer, the "Robert Dollar," of which those ships are duplicates. The "Robert Dollar," according to British measurement is of 3,420 net tons, but American ships of this size, he tells us, run on an average of 4,283 net tons—a difference of 863 tons. Now since all port charges, pilotage, drydocking, etc., are charged on the net tonnage, the American ship in foreign trade pays 25 per cent more than the ships of any other nation. We agree with him that, since this difference is paid in foreign ports and to foreign nations, it is certainly the duty of Congress to let the country know why our ships are thus penalized under our laws.

Then, there is the matter of yearly inspections. Under American regulations, when these are made the ship must be free of cargo and the boilers filled with cold water; therefore, during inspection, all handling of cargo must be suspended. With British ships there is no interference with work, since the inspection is done piece-meal and in such a way that the loading and unloading can go on. If the inspection cannot be completed, the vessel is allowed to proceed to the next port, where it is finished. Boiler inspection, moreover, requires a cold water hydrostatic pressure once and a half times the working steam pressure, which must be applied once a year; this, Mr. Dollar tells us, wrecks the boilers and pipes and shortens the life of the boilers. No other nation calls for this and yet there are no more explosions on foreign ships and on our own.

Furthermore, our engine room crews are larger and this experienced ship-owner asks: "If it be true as Secretary Redfield says, that Americans do more and better work than any others, why, on a 10,000-ton deadweight American steamer, does it take 30 per cent more men in the engine room than on a similar-sized steamer of any other nation."

Then there is that clause of the Seamen's Bill which states that 75 per cent of the crew in each department shall understand any order the officers may give. It is intended to prevent carrying Chinese on the ships to meet the competition of the Japanese; but we are reminded that the Japanese are free to carry Japanese crews and Japanese officers, with the result that today Japan has full control of the commerce of the Pacific Ocean.

As regards the clause in the Seamen's Bill providing that the seaman can demand half of the wages he has earned at every port he goes to, Mr. Dollar tells us that it has done great harm to American ships, for the reason that it is a temptation to the men to drink heavily while in these foreign ports. If all the world were going to be dry after July 1st, this regulation might stand; but under existing conditions, it is a most serious handicap to the efficiency of our vessels.

Finally, Mr. Dollar puts in a strong plea for private as against government ownership, and we are glad to note that Mr. Hurley is in thorough agreement with him on this point. Fortunately, the present government seems to be undergoing a change of heart on the subject of government ownership, driven thereto by the cold logic of facts.

International Trademark Registrations

AFTER waiting nearly nine years, we are at last to receive some of the benefits of the Pan-American Trademark Convention. It now becomes possible for American citizens to obtain a registration at the Bureau of the Northern Group of countries, and under this single registration to secure trademark protection in all those countries of the Northern Group which have ratified the Convention. Besides the United States, these countries are Cuba, the Dominican Republic, Honduras, Nicaragua, Costa Rica, Guatemala and Panama.

Unfortunately the benefits do not extend to the Southern Group of countries because of the delay in the ratification of the Convention by the South American states. It is also to be regretted that the necessary legislation has not been enacted in the United States to permit the registration in this country of all trademarks registered in the International Bureau by citizens of other countries now members of the Convention. This brings up the same old question of reciprocity, which our international patent and trademark attorneys find presented to them in the most awkward forms. The definition of reciprocity adopted by the legislators at Washington seems to be that the other fellow has got to reciprocate first; and then, when we get good and ready, we will reciprocate. This works fairly well when employed on one side only; but when both sides adopt it, or when one side gets tired waiting for the other to act, there is likely to be some embarrassment. This is felt not only in connection with the rights of Americans to the full benefits of the Pan-American Convention, because of the inordinate delays in granting full and reciprocal rights to the citizens of the other countries which have ratified the Convention, but it operates equally in connection with our failure effectually to reciprocate in other patent and trademark matters.

Probably the most harassing of our failures is with reference to the granting of extensions of time for the filing of patent and trademark cases and for the payment of fees, where the delays have been caused by the war. The other leading countries are granting such extensions freely, with of course the expectation of reciprocity; and these extensions have been taken advantage of by many American citizens to protect valuable rights abroad. If Congress does not soon make a move in the direction of reciprocating these concessions from the existing letter of the law, it is feared that the one-sided "reciprocity" heretofore extended to us abroad will be withdrawn, of course retroactively.

Congress must eventually be brought to realize that, to safeguard our patent and trademark rights, it is necessary not merely to enact laws which will afford protection to our citizens in this country, but likewise laws which will afford substantial protection for the rights of foreigners here. Only in this way can our citizens hope to obtain in turn the fullest protection abroad. It is to be hoped that the education of Congress upon this point will not have to be purchased at the price of heavy loss in American rights abroad.

Phantom Limbs

THERE are certain scientific topics which seem to be endowed with perpetual youth, in the sense that whenever they are broached, in popular if not in scientific circles, they are invested with an air of novelty. This remark is suggested by an article in a recent number of a well-known Italian journal. The author describes the case of a man whose entire left leg has been amputated, but who nevertheless complains of an itching under the sole of the left foot, besides other definitely localized sensations in the missing member.

We find this article noteworthy, though not for the reason that, presumably, prompted its publication. The hideous toll of war has lately involved the mutilation of human beings on an unprecedented scale. Now it is a fact, perhaps unfamiliar to the average reader, that the illusion of "phantom limbs"—to borrow a felicitous expression from Dr. Weir Mitchell—far from being rare or exceptional, is almost universal among persons who have undergone an amputation. Among 90 cases, including a greaty variety of amputations, Mitchell found only four in which there had never been an illusion of this kind. Therefore it is a matter of some interest, not that a single example of the phenomenon has recently been reported in a single publication, but that the popular magazines and the newspapers are not, at this juncture, full of similar stories.

Can it be that one of the perennial "novelties" of science has at last ceased to be novel? Just how familiar is the subject of "phantom limbs" to the public at large? Just how familair is it to medical men who have not made a special study of nervous phenomena?

One of the best discussions of this topic is that given by Weir Mitchell in his book "Injuries of Nerves," published in 1872. The literature, however, goes back to the sixteenth century, when the phenomenon was well described by Ambroise Paré. In recent times Dr. Charcot has given some prominence to the subject. Whoever cares to pursue the matter will find fairly good bibliographies appended to two doctoral theses of the Paris Faculty of Medicine; one by Auguste Arondel, published in 1898, and the other by C. Gulbenkian, published in 1902.

The fact that a great deal has been written on this subject does not, by any means, imply that it is widely familiar. Nearly every one of the scientific topics that are continually cropping up as "novelties" in the press can boast of a voluminous literature.

We confess to being consumed with curiosity to know why the great war has not brought forth a flood of stories concerning pains and other sensations in missing limbs.

To Our Subscribers

OUR subscribers are requested to note the expiration date on copies of Scientific American. If they will send in their renewal orders at least two weeks prior to the date of expiration, it will aid us greatly in rendering them efficient service.

Naval and Military

Fine Tribute to Our Reserve Officers.—A well-deserved compliment was paid to the officers of the United States Naval Reserve Force by Rear-Admiral W. S. Sims in the course of a Victory Loan speech in New York city. "Had it not been," said he, "for the splendid work of the reserve officers, I do not know what we should have done. The accomplishments of these young men were really wonderful. Starting as raw landsmen, many of them within three months became as good deck officers as were our own men, and many of them were on the bridges in command of destroyers."

Brooklyn Army Supply Base.—Not many people in the country are familiar with the great army supply base which was built in Brooklyn for accumulating and forwarding supplies to the American Expeditionary Force in France. One of the new reinforced concrete warehouses measures 980 feet by 200 feet; another is 980 feet by 306 feet; and both are eight stories high. There are three, covered, double-decked piers 150 feet wide by 1,300 feet long; and there is an open pier 60 feet wide by 1,300 feet in length. All of this work was emergency construction which was put through in a remarkably short time.

German Submarines on Exhibition.—The disposition of the five German submarines which were brought to the United States will be as follows: U-111, after being shown at Portland, Boston, etc., will lay up at New London. U-117, after visiting Philadelphia, Wilmington, Charlestown, etc., will be assigned to Washington, D. C. UB-88 will pass by way of Savannah, Tampa, Mobile, and the Mississippi to St. Louis, and then by way of Galveston, Key West, and the Panama Canal to San Pedro. UB-148, after exhibiting at and about New York and the Hudson River will lay up at New London, and UC-97 will pass by way of the St. Lawrence and lake ports to a berth at the Great Lakes Naval Training Station.

Maintaining Ordnance Material.—The General Staff has prepared a table showing the ordnance material which has yet to be completed. Although large orders have necessarily been cancelled since the signing of the armistice, a vast amount of needed material will be completed, for the War Department has determined to maintain an amount of ordnance material amply sufficient for an army of half a million men. Thus we are going to complete 396 240-mm. howitzers; 392 6-ton tanks; 341 155-mm. guns; and 100 30-ton tanks. The total number of tractors when the present contracts are completed will be 1,000 2½-ton; 4,000 5-ton; 2,800 10-ton; 267 15-ton; and 400 20-ton tractors. Of tanks the number is 15 3-ton; 950 6-ton; and 100 30-ton tanks.

Drydock Shortage at New York.—It is stated that at the present time in the port of New York there are only 15 drydocks that can accommodate ships whose length is 350 feet. That is to say there is accommodation for about 1,500,000 tons of ships. If the Shipping Board's expectations are realized, the United States will possess 16,000,000 deadweight tons of shipping in 1920, and there are, according to an article by Ralph U. Fitting in the *Evening Post*, only about 55 commercial drydocks over 350 feet in length in the entire United States. The English found that one dock capable of taking ships 350 feet in length will handle about 95,000 tons of ships. Unless we take the matter in hand at once, our own fleet will be severely handicapped by lack of docking facilities.

A Tunnel at Gibraltar.—Now that the construction of the Channel tunnel is assured, military and commercial interests are turning their thoughts to the Straits of Gibraltar and forecasting the advantages which would be secured by building a tunnel between the European and African coasts at that point. An engineering journal in Great Britain states that whereas it now takes three weeks to go from London to the Cape, with the Channel tunnel and one under the Straits of Gibraltar it would be possible, when the Cape-Cairo Railway and other rail connections are completed, to go from London to the Cape in eight days. Unfortunately, the Straits are about 1,200 feet deep and unless the underlying rock is impervious to water, no tunnel can be constructed there, since the limit for the pneumatic process is about 175 feet.

Science

United States Fixed Nitrogen Administration.—An organization bearing this title has been formed under the joint control of the Secretaries of War, Navy, Interior and Agriculture, for the purpose of taking over and operating all the Federal plants designed for the fixation of nitrogen and the manufacture of ammonia and nitric acid.

American Society of Mammalogists.—The organization meeting of this new society was held at the U. S. National Museum, in Washington, April 3d and 4th, with a charter membership of more than 250. Dr. C. Hart Merriam was elected president. The society is to devote its attention to the study of mammals in a broad way, including life histories, habits, relation to plants and animals, evolution, paleontology, anatomy, etc. The society's *Journal of Mammalogy*, which is to start publication this year, will include popular as well as technical matter.

A Training Course in Public Health Administration.—In order to enable busy public health officials from various parts of the country to come into contact with American leaders in matters relating to public health and acquire valuable new ideas, a brief practical training course in public health administration is to be given in New York City this spring, under the auspices of the New York Academy of Medicine and the New York Bureau of Municipal Research. The course will cover a period of six weeks, beginning April 30th. The first three weeks will be devoted to lecture-conferences conducted by experts of national reputation, and the last three weeks to field study and observation of health work and institutions in and about New York City. Attendance during the second half of the course will be optional. Applications for enrollment may be sent to Dr. Carl E. McCombs, Bureau of Municipal Research, 261 Broadway, New York City. The present plan is to limit enrollments to 50, and to give first consideration to those actually engaged in public health administration, but these restrictions may be relaxed.

A Chemical Test of Ocean Currents.—During a recent expedition on behalf of the Carnegie Institution, Dr. A. G. Mayor noted that in the tropical Pacific, whenever the ship met with a decided countercurrent running in an easterly direction against the prevailing westerly drift, the water became relatively acid. This easterly current is often encountered in the region of such low-lying coral islands as Palmyra and the Phoenix or Union Groups, and is dangerous to vessels at night, as there are no lighthouses, and the vessel may be driven on a reef before the presence of the current has been noticed. Whether the water is relatively acid or alkaline can easily be determined by the use of some such indicator as thymolsulphonephtalein. One has only to mix the water with a few drops of the dye, and if the mixture is greenish-blue it is alkaline, while an approach toward acidity produces a more nearly yellow color. This method may also be used to determine when a ship passes out of a current of tropical origin, which, being warm, is alkaline, into another current of colder water, which, on account of its low temperature, is less alkaline than the sea-water of the tropics.

Russian Explorations of the Siberian Coast.—One of the most surprising pieces of news that has come lately from Russia is that, in spite of untoward political conditions, an ambitious campaign of survey work in the Arctic Ocean along the Siberian coast was undertaken in the summer of 1918 under the direction of the Russian Hydrographic Office. A programme of these undertakings was published last November in the *Comptes Rendus* of the French Academy of Sciences by the well-known oceanographer, General J. G. Shokalski, who is still in Petrograd, so far as known. Subsequently General Shokalski has found means of sending letters on the same subject to some of his scientific friends in the United States. The explorations were to be carried out by two parties. One, working from the White Sea eastward to Cape Chelyuskin, was to be under the command of Captain Vilkitskii, the discovered of Nicholas II Land and the leader of the expedition which made the Northeast Passage from Bering Strait to the Atlantic Ocean in 1914-15. Another party, surveying from Cape Chelyuskin to Bering Strait, was to be commanded by Capt. P. A. Novopashennii. Several new radio stations were to be established to facilitate the work of the expeditions.

Industrial Efficiency

Where the Building Problem is Being Solved.—One of the cities that has been foremost in beginning to solve after-the-war problems is Portland, Ore., which is coöperating in the building campaign of the United States Department of Labor. According to plans the city will construct not less than 2,000 houses this year. Oregon is the source of an immense lumber supply and there is an abundance of skilled labor. For that reason the outlook is reported to be most encouraging for building activities that will absorb at least a part of the surplus labor.

New York's Housing Problem.—While the United States Department of Labor has estimated that there exists in the country a shortage of 500,000 houses as a result of the stoppage of building by war conditions, it is probable that half a million does not cover the actual deficiency. Reports from New York city show that living quarters there are now at a high premium. Rents have gone up approximately one-third, moderate-priced apartments being subject to the largest increase. Thousands of war workers have been crowded into the city and the regular growth has been advanced in many other ways. A survey of 152 cities shows an encouraging increase of building, although it has not yet reached one-third of the normal volume of construction.

The Coal Cover.—The small and unsuspecting coal cover has, without a doubt, been the direct cause of a great many serious accidents that have done their share in compiling the grand total of accidents that have occurred on and about public buildings. A great many of the injuries caused by coal covers could have been prevented if a single ounce of precaution had been taken by the caretakers in charge of the buildings. Investigations prove that, in a great many cases, the direct cause of an injury caused by a coal cover has not been due to the negligence of the owner, nor to the defective condition of the cover, as a means had been provided for securing the cover to its moorings and the casting was in the best of condition. The direct cause is that the janitor, or others, has not securely fastened the chain when the cover has been put back in place after it has been removed to allow coal to be placed in the cellar.

Why Factory Smoking Should Be Stopped.—An important hearing on fire prevention was recently held in New York city, before the State Industrial Commission. The danger of fire caused by smoking in factories was discussed by several witnesses. One authority made the suggestion that the regulations prohibiting smoking in factories be extended to 24 hours a day, so that an employee could not smoke until he left the building. This authority also emphasized the danger of fire caused by employees lighting cigarettes and cigars as they were leaving the factory, and carelessly throwing the lighted match aside. Discontinuance of celluloid eye shades was also advocated, because they were so inflammable. Several instances were cited where eyeshades had caught fire and the wearer had been severely burned. It was pointed out that eyeshades of this kind were not only a danger to the wearer, but to his fellow-workmen as well.

Scrapping the German Submarines.—Considerable importance is attached to the recent purchase of 25 German submarines by a British firm of London and Swansea, which will undertake to break up these vessels and dispose of the scrap metal. This firm is a large ship-breaking company, and during the war handled considerable quantities of scrap iron brought over from the battlefields of France. It recently purchased at auction 25 German submarines, 12 of which it intends to bring to its works in Swansea. It is estimated that the breaking-up value of each vessel will be $12,166, and for the dozen $145,992. The work on each submarine will occupy 10 weeks, and considerable additional labor will be employed by the company. The scrap metal thus obtained will be sold to the various tinplate and steel mills in the Swansea district. This development of the ship-breaking industry in Swansea will be a very important one not only to the port and as a means of employment, but because it will provide great quantities of high-class material for the tinplate and steel industries. The remaining 13 out of the 25 submarines purchased will be broken up by the same company in other ports of the United Kingdom.

The Assyrian city of Nimrud, with the walls of an Assyrian palace projecting from the ground

Large stone monuments in the public square of Assur. One of them bore the name of Shamiram, the Semiramis of ancient legend

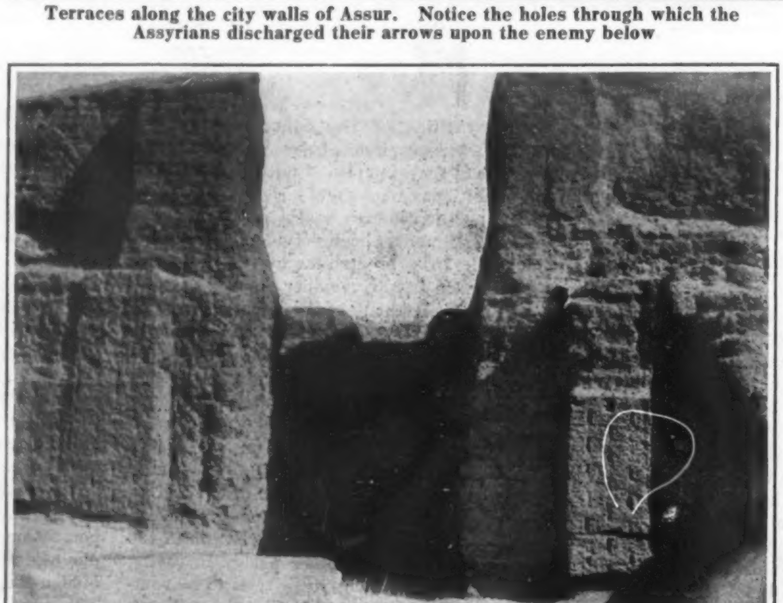
The Future of the Archaeologist in Mesopotamia

A Wonderful Field Opened Up to the Explorer

By Edgar J. Banks

ONE of the good things to follow the evils of the great world war is the opportunity for excavation work among the buried cities of the Orient. Did you ever stop to think that nine-tenths of the ruins of all the cities of the ancient world are or have been in Turkish territory? A century ago the Parthenon on the Acropolis at Athens was a Turkish powder house. The sites of all the seven wonders of the ancient world have been owned by the Turks. The cities of the Greek mainland and the islands, Asia Minor, Phrygia, the Hittite Land, Armenia, Assyria, Babylonia, Arabia, Syria, Palestine, Egypt and Carthage and other cities of northern Africa, all the lands where ancient history was made, with the single exception of Italy, have been ruled by the Turks. And no people have been less worthy to inherit the homes of past civilizations. Whenever a Turk has found a human portrait sculptured in stone by some ancient artist, it has been his sacred duty to destroy it; the Mahommedan religion does not permit the representation of the human or animal form. Thus many a priceless treasure of the early world, treasure which every man respected till the Turk came, has been made worthless. Many a buried city has been used as a quarry for building stones, and its treasures of inscriptions and sculptures have been lost to the world. The temple of the wealthy Greek city of Cyzacus on an island in the Sea of Marmora is an illustration. An aged Turk long made it his occupation to search among the temple ruins for marble. With some of the larger marble blocks he built a lime kiln; the rest of the marble he broke into fragments to throw within the kiln and convert to lime. It mattered little to the Turk if the marble bore an early Greek inscription, or was a beautiful piece of statuary or a sculptured capital which any European museum would prize, it was broken and turned to lime. At Mosul, just before the war, a great stone bridge for the Bagdad railroad was built across the Tigris. Every stone in the bridge was taken from the walls of ancient Nineveh. On the summit of Kouyunjik, one of the mounds of Nineveh, the workmen found a huge human-headed marble deity which once guarded the entrance to the palace of an Assyrian king. I tried in vain to rescue the monster from the hands of the vandals. I saw the men break it up, load the fragments into baskets on the backs of donkeys, and transport them to a lime kiln. The lime was used for cementing the stones of the bridge. The walls and temples of Babylon, and the palace of Nebuchadnezzar, have long been quarried for bricks. Even the streets of the neighboring city of Hillah are paved with them, and with every step you may tread upon the name and the inscription of the great Babylonian king. Inscribed bricks have been used in the construction of great dams across the Euphrates, and yet when the archaeologist would seek to take a single brick from the country, he would run the risk of arrest and imprisonment. Scores of similar tales might be related of the vandalism in all parts of the Turkish Empire.

Terraces along the city walls of Assur. Notice the holes through which the Assyrians discharged their arrows upon the enemy below



The city gate of Assur, the first capital of ancient Assyria. The modern name of the ruin is Shergat

Before 1877 Turkey possessed no archaeological law, and until then everyone who could command the means and satisfy the owners of the land and the local authorities might dig wherever he would. Therefore it was before 1877 that the great archaeological collections found their way to the British Museum and the Louvre. Since then the Turkish government has placed every possible obstacle in the way of archaeological research. To obtain permission to excavate even in the remotest parts of the empire has been a long and difficult process. It took three years and about $8,000 to secure permission to excavate the Babylonian mound Bismya, which lies so far in the Mesopotamian desert, among wild Arab tribes, that few Turks have ever dared to venture there. That was in 1913, and since then permission to excavate has not been granted to any European, excepting to the Germans to continue their work at Babylon. During that time it has been denied to many. When the permission is granted a commissioner is appointed by the Ottoman museum authorities to accompany the excavator and to take charge of all the antiquities which may be found. His salary of about $100 a month and expenses must be paid by the excavator. The one who has been to all the trouble and expense of finding the buried treasures has the right only to sketch or photograph them before they are sent to the Constantinople museum. Of course the commissioner may be bribed to permit the antiquities to be smuggled from the

(Continued on page 520)

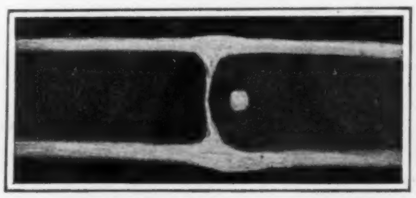
Plants That Make Stones

By S. Leonard Bastin

It is well known that plants are continually taking up various mineral substances from the soil. Most of this matter is spread about in various parts of the organism and is not very apparent to the casual observer. Now and again, at certain points, there will appear an accumulation to such an extent that stones are produced. Thus, occasionally, inside the stems of the bamboo a hard rounded mass is found just at the joints of the cane. These are of a silicious nature, and probably represent an excess of silica taken up by the plant. Even more interesting are the cocoanut stones which can at times be dug out of the endosperm of some kinds of cocoanut. These are usually round but they are sometimes pear-shaped. In color they are white, and not unlike pearls, although not so lustrous. As a rule these stones are about the size of small cherries and they are quite as hard as felspar or opal. On account of the rarity of these cocoanut stones they are very highly valued by the inhabitants of Java and other East Indian islands. It is generally considered that they act as charms against disease. These stones have been carefully examined and they are held to be composed of pure carbonate of lime.

Somewhat similar processes are occasionally present in pomegranates. Apatite has also been discovered in teak wood. The curious water plants called Stoneworts (*Chara*) cover themselves with calcareous deposits. This is so much the case that, as these plants die down each year, the bottom of the pond or lake is appreciably raised by the accumulation of lime, which of course does not vanish with the decay of the stems.

The stonewort secrets so much lime that its autumnal decay raises the level of the water bottom



Stones laid down in a bamboo stem (left) and in a cocoanut (right)

Mobilizing a Lady Bug Army to Fight the Aphis

By Horace E. Thomas

Now that spring has come and the chill of winter no longer retards the growing grain a strange army is being marshaled forth into the cereal fields of the Pacific northwest. Its divisions, brigades and regiments are composed of lady bugs and they are sent out to attack their natural prey, the aphis.

Scientists have long recognized in the lady bug, lady beetle or lady bird, as it is variously called, a beneficient agency in its disproportionate struggle to exterminate the aphis, or plant louse. Heretofore the bugs have exercised complete freedom in their go-as-you-please efforts to hunt down and devour the aphis. Now, however, the lady bug, which perhaps is least offensive of all the huge bug family, and for which nearly everyone has a sort of friendly feeling, has its campaign mapped out for it and will be sent where it may do the most good by enjoying unlimited gastronomic activity.

The lady bug hibernates in the winter. It is possessed of a tropism that warns it with the approach of cold weather to seek shelter. In colonies numbering a million or more bugs it bivouacs in the mountains and foothills, There, protected by rocks and crevices, it lives safely through the cold weather. When it is aroused from its stupor by the spring sunshine it again makes its way to the lower levels where its favorite food is the aphis, most destructive of grain and vegetable pests. The present effort is to gather the lady bugs from their winter retreats, care for them in artificial storage during the winter and release them in the spring where a plague of aphids is most feared.

So far, scientists agree, the attempt to use the beetles for aphis control is in an experimental stage. By some it is believed that the lady bug army will accomplish more toward eradicating the aphis if left to its own devices. Others consider the plan as promising permanent relief to the farmer, at least in some localities. All authorities agree that it is worth trying and are coöperating to make the test complete and decisive. That it is a matter of real importance, as well as interesting as a novelty, will be realized when it is considered that the annual plant destruction by aphids in the Pacific northwest alone entails a loss of from $10,000,000 to $20,000,000.

Nearly 100,000,000 lady bugs will be distributed in the state of Washington this spring. More than 25,000,000 of them have been stored and are ready for release at any time. Caches of the others were located and they are being assembled for distribution when the proper time comes.

Agents of the United States Forest Service have taken the lead in collecting the beetles. The forest ranger has exceptional opportunities to find their caches. When he came upon a colony he reported it to the county agricultural agents, who were coöperating in the work. It was no trick at all to scoop the bugs into sacks and boxes which were to be their new home. The receptacles were partly filled with excelsior which served as a roost and the bugs were stored away to be kept through the winter at as constant a temperature as possible, in the neighborhood of 38 degrees above zero. In one instance an abandoned brewery was their temporary home; another huge colony occupied an apartment in a meat packing plant, which was kept comfortably near the freezing point and where there was no fuel problem to worry them. On bright days they were taken out to sun for a few hours to check any fungus growth that might kill the beetles.

The Bureau of Entomology of the Department of Agriculture, through its station at Forest Grove, Ore., has coöperated in the enterprise to the extent of collecting data and giving advice. Results will be carefully tabulated and a complete survey prepared for publication. The men in the entomological service have been careful not to give too great encouragement to the farmers. That the artificial distribution of lady bugs may be beneficial under certain conditions, they believe; but where the aphis is at its worst they have little hope that beetles can be assembled in sufficient quantities to combat it.

This opinion is shared by Prof. A. C. Lovett, entomologist, of Oregon Agricultural College, who has made a thorough investigation of the lady beetle as a natural foe of the aphis. In normal years, he says, the aphis pest is kept under control by the lady bug and other enemies, such as the syphus fly, the larvae of the lace wing fly and the lampyrid beetle, all of which, including the larvae of the lady bug, devour aphids in great numbers, and a minute wasp that kills them by its sting. The common impression that hot weather kills aphids is a mistake, he adds; the fact is that warm days are favorable to the insects that destroy the aphid. When a few warm spring days are followed by cool, damp days the aphis thrives because its insect enemies are inactive under such conditions.

When there is a real outbreak of aphis, such as practically destroyed the vetch crop of western Oregon in 1918, there is little hope of relief from lady bugs, according to Professor Lovett. "The climatic factor then presented an insurmountable barrier to the successful use of natural enemies," he says, and continues:

"In an experiment carried on last year, 210 pounds of aphids were collected from a 12-acre field of vetch. It was estimated that this constituted 60 per cent of all present. Therefore, on this field there were approximately 350 pounds of plant lice. One gram of aphis were counted, amounting to 513. There would be, then, approximately 254,000 aphids in a pound or 88,900,000 on the 12-acre tract. Figured on this basis 25,000,000 lady bugs would, if devouring their maximum of 200 aphids daily, succeed in controlling the plant lice on 77 acres. When we consider the hundreds of acres of vetch

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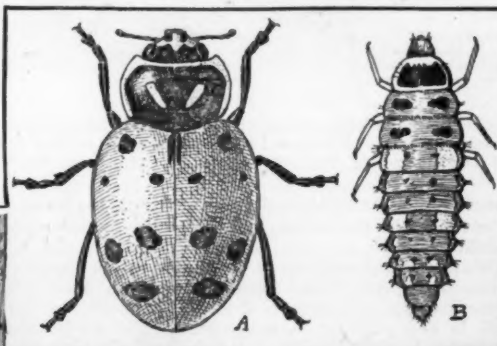
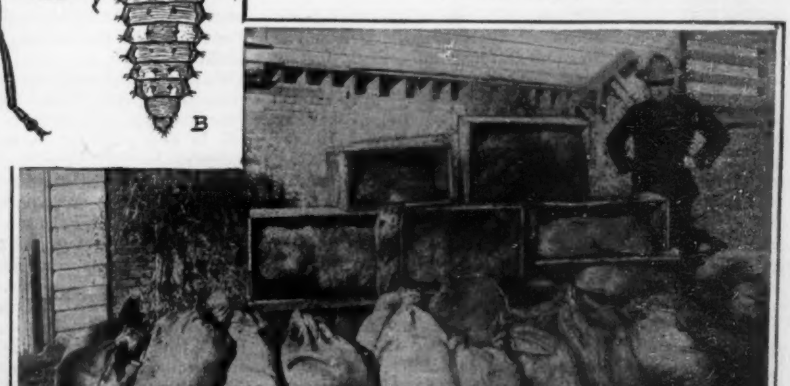




A lady-bug colony, at home for the winter, from which two million bugs had been removed before the picture was taken. At the right, sacks of the bugs prepared for "live storage" in a safe place; above, adult (A) and larva (B) of the aphis-eating lady bug

The French Problem of Reconstruction—III

The Practical Methods by Which the Devastated Home, Farm and Industrial Plant Are Being Rebuilt

By C. H. Claudy, Special Correspondent of the SCIENTIFIC AMERICAN in Paris

THE outstanding fact, to the onlooker beyond the seas, is that France has decided that all France shall pay for the damage done to part of France. When and how Germany shall pay to France does not enter into the question. Just now, all of France is going to pay for the damage done to part of France. It is, perhaps as fine a demonstration of the unity of a people as has ever been seen in all history.

Practically, it means that the Government has voted to pay individuals in full for the damage they have suffered, "damage" meaning to building, to land, to furniture, to industrial plant. Probably in no other way could anything approaching a quick result be obtained, but to see a whole people voluntarily taxing themselves in addition to heavy taxes imposed by the war, to rehabilitate the invaded land and reëstablish the refugees is none the less inspiring.

The cart is thus put before the horse—the meat of the remedy before the means of applying it is described, because it humanizes a subject otherwise apt to be considered somewhat dry. Reconstruction agencies, as given birth to and brought up by governments, are not apt to seem thrilling, yet even one somewhat oversteeped in government red tape and slow methods can find the thrill in this effort of a sorely tried people to heal their wounds and make "La Belle France" as speedily as possible what she was before the war.

In the United States we are so accustomed to the sound of money chinking in appropriations which run into billions that we are a little apt to look at the French appropriations as small. But it should not be forgotten that the standard of living of the French country dweller (it is said with all respect to the heroic French peasant) is decidedly lower than that of the country districts of the United States, and that it requires much less to give him a home and put him to tilling his soil than would be the case were a similar amount of devastation accomplished in the United States.

The French Government began assistance to invaded regions almost as soon as the war started. Six hundred thousand dollars was voted the invaded communes of the Marne in December, 1914. In the budget for 1915 the French Government included sixty millions to be applied by the Minister of the Interior in relieving distress in the invaded regions. Up to August 5th, 1918, thirty-six millions of this had been spent, six to drain mines, six for materials, two and a half for general supplies and the rest individually in ten invaded Departments.

Governmentally, reconstruction work grew as all government work does grow, here a bureau, there a committee, here a special service, there a special department, until the various unrelated and uncorrelated efforts grew top-heavy and confusing. The Ministry of the Interior started a special service to prepare for reconstruction as early as 1916. Later there was an inter-ministerial committee supposed to correlate the activities of different governmental departments. A law was proposed compelling city planning for destroyed towns; not yet law, it has been supplemented by requests, usually met in the spirit in which they are made. An organized service for handling refugees' interests, and another for repairing damaged buildings was put in operation, arrangements were made for making advances to returning refugees of a certain amount of the probable total indemnity they would eventually receive, the Ministries of Commerce and of Agriculture have been given appropriations to make purchases for their respective reconstructions, a special service was inaugurated in 1917 for getting the soil back into tillable shape, and a variety of similar undertakings put under way.

Naturally, with so many different activities going on it soon became evident that a central head was an essential if the ends of efficiency were to be at all well served. Consequently, the Ministry of Liberated Regions was established, divided into four main branches, having to do with the general reorganization of local life, payment of war indemnities and coördination of all relief agencies, a technical service of reconstruction and soil rehabilitation, an office of agricultural reconstruction and an office of industrial reconstruction. One head, one Ministry, one location in Paris, the many agencies working towards getting France back to be what France has always been, are now in a position to function, if not with American speed, at least with a patriotism and a singleness of purpose of which any American might feel proud.

Since the armistice, the industrial reconstitution office has been absorbed by the old Ministry of Armament, which is now engaged in changing munitions plants back to a peace basis.

So much for the machinery. What it does as the wheels revolve has been indicated in the opening paragraphs. Of course, it does many things, but none more important than this giving of aid to the refugee, feeding him, clothing him, giving him tools, and last and best, giving him advances on his ultimate total indemnity that he may reëstablish himself permanently in the country from which he was driven, and thus aid in reëstablishing France.

Advances are made up to 90 per cent of the appraised value of property, valued according to pre-war standards. This leaves a wide margin of safety, for while the final bill is not yet law, it seems practically settled that indemnities will be paid to cover the cost of replacement in kind regardless of increased cost of both materials and labor. This fine, sportsmanlike and liberal attitude of France—all of France—toward the suffering part of France is rather overlooked in these days of exciting Peace Conference and League of Nations publicity. But it is fine, none the less. France says to her refugee: "You have suffered. Your house was destroyed, your land ruined, your furniture stolen or burned, your cattle commandeered or killed, your whole plant taken from you. We propose to replace it. If your house cost 5,000 francs to build in 1914 you can have 4,500 now, to replace it, and as soon as we can get this legislation passed, you shall have 10,500 francs more if it costs three times as much to build now as then. And the same with your tools and your cattle; you, who have bled for France, shall be paid by France, as much as France can pay." Is it any wonder the very babies in the cradle cry, "Vive la France!" if they cry at all?

Meanwhile, the State has taken the right to requisition ruined buildings for building material, although no objection is made to any man taking the ruins of his own property to rebuild it anew, if he will and can.

To the peasant, next to his wife and children, his household goods have always been his most precious possessions. The stories of refugees with cars containing beds, chairs, stoves, cradles, creeping along the roads to safety are true stories; your farmer Frenchman would almost part with his eyes before he would give up his Lares and Penates. So it is a very vital thing to him that his government has agreed to give him damages for lost household goods up to $2,000 in value. As yet he cannot touch the whole indemnity. If his total indemnity is $2,000 he can have $200 for himself and $40 for each other member of his family. Moreover, the state will sell him furniture if he wishes; he does not have to go to the open market. Your Frenchman is nothing if not "canny" in money matters. Any visitor to Paris these days will testify that what the French do not know about a bargain is not worth learning! So the French government needed no instructions that furniture and household goods were going to cost a lot of money. It looked like an easy thing; the government paying refugees money with which to buy furniture. But the government saw the point and squelched the furniture profiteer, if he existed, by buying vast quantities in advance of the payments made to refugees. Such furniture includes chairs, tables, beds, cupboards and wardrobes and also doors, windows and shutters.

While there is no waiting (whoever will can get to work on his individual reconstruction problem at once), there is a full knowledge that at best the task must be slow. Hence, in preparation for eventual full reconstruction the government is now buying building material, as well as making preparations to house and feed workmen, in temporary quarters, so they may start the peaceful invasion—for rebuilding, of the invaded and destroyed regions. Such materials will be given out to coöperative groups of contractors by the government according to rigid priority rules.

Coöperative effort is being employed wherever possible, as stifling competition for both labor and material, and making the reconstruction a community rather than an individual matter.

For instance, in several cases south of Chalons-sur-Marne government organized communities have formed coöperative societies which have brought together property owners (former property, alas!) which, employing a contractor and an architect in common have been able to save much money in making purchases and by having projects of sufficient size to be seen by governmental eyes, have been able to command the service of some of the nearly nine hundred thousand German prisoners who are now working out a poetic justice and their own destinies by laboring to rebuild the France they did their best to destroy!

Between two fires

After a hail of metal from American batteries as a preparation, U. S. infantrymen captured this village of Vaux on July 1, 1918. Later the Boche attempted to take it back, and occupied it for the brief space of an hour or so. The Americans recaptured it and progressed far to the north. The village itself—caught between two fires—was a ruin.

Scratched Joints Versus Smooth Joints in Gluing

THE common assertion that scratched surfaces make stronger glued joints than smooth surfaces seems hard to prove. Comparative tests made on several occasions by the Forest Products Laboratory all indicate that the strengths of these two types of joints are practically the same.

The test specimens used by the Laboratory were pairs of hard maple blocks, some with smooth and some with tooth-planed contact surfaces. These blocks were glued with a high grade hide glue, allowed to stand for a week, and then sheared apart in an Olsen universal testing machine. Four joints of each type were compared in a single test.

Light and Progress

The Part Played by Artificial Illuminants in the Development of the Human Race

By M. Luckiesh

"O first created beam and thou great Word,
'Let there be light and light was over all.'
Why am I thus bereaved thy prime decree?"
MILTON.

THUS through "Samson Agonistes" comes the lament of Milton, whose eye-sight has failed. Perhaps only through a similar loss would we fully appreciate the tremendous importance of light to us; but imagination should be sufficiently capable, if duly exercised, to convince us that light is the most essential and pleasure-giving phenomenon which mankind experiences.

The importance of light is early recognized in mythology, being the achievement of the Creator immediately following the creation of "the heaven and the earth"; and the word "light" is the 46th word in Genesis, the First Book of Moses. Light has played a conspicuous rôle in the mythology and religion of many peoples—in many cases the leading rôle. Throughout all time both primitive and civilized races have had gods and goddesses of light. Even today there are people who worship Light as the god of all — and in a sense they are not wrong.

The poetry of all ages abounds in the use of light and color for clothing the emotions, suggesting the possibility of a language of color, at present but vaguely appreciated. The poet has availed himself of the powers of light and color on the imagination in exciting, heightening, and extending ideas and sentiments, in the construction of epithets, in the decoration of figures, natural rhetorical, and in all the imagery and witchery of his art. Light and colors have been used symbolically, sometimes merely fancifully or conventionally, but even these uses are not to be rejected, because by association and common consent they have acquired signification similar to words. Light and colors doubtless have their effects upon the passions, feelings and intellect even though their language is not at present plain to us. Is it not possible that we are not yet cultivated to the point of due appreciation and comprehension just as the highest type of civilization a few centuries ago would not have been able to comprehend the modern musical symphony? Light does have emotional value through colors — the music of light.

Light has many synonyms, but one which we would apply as very befitting is Progress. The truth of this is readily shown by reviewing the history of light from the dawn of the race to the present time. If we go back in imagination to primitive man whose activities were bounded by sunrise and sunset, we gain an idea, by contrast, of the complexity with which light is interwoven into our activities. In our retrospection, written history fails us long before we reach the primitive ages. However, we can safely trust our imagination to penetrate the fog of centuries of unwritten history and find primitive man huddled in his cave as daylight wanes. Impelled by the evolutionary spirit of progress primitive man desired to extend his activities beyond the boundaries of daylight and eventually learned to make fire. This furnished him with heat and light which achievement elevated him from the brute kingdom and marked the beginning of the genus homo.

From the pine knot of primitive man to the wonderfully convenient light sources of today is a long interval consisting, as appears retrospectively, of small and simple steps, long periods apart. Measured by our present standards, progress was slow in the early ages and we are inclined to impatience as we follow the history of light and progress even in the comparatively recent centuries of written history. As is ever the case civilization must constantly readjust itself to the discoveries of science and the developments of invention. Only 100 years ago the proposal of lighting the streets at night met with loud protests based on various reasons, theological, moral and economical, but after adjustment to the new idea, civilization is equally vociferous in complaining of the darkness of streets.

The burning fagot rescued mankind from the shackles of darkness and the grease lamo and tallow candle have done their part in paving the way for man's achievements of today. Artificial light extended man's activities and has been an important factor in mental development. It perhaps has ever been true since the advent of artificial light that the intellect has been largely nourished after the completion of the day's work.

Artificial light has been an important factor in the great progress of the present electrical age. Man now burrows in the earth, navigates under water, travels on the surface of our sphere, and sails among the clouds piloted by light of his own making. Progress does not halt at sunset, but continues 24 hours each day. Building, printing, manufacturing, commerce, and other activities are prosecuted continuously, the working shifts changing every eight, ten, or twelve hours, regardless of the rising or setting sun. Artificial light affords man an opportunity for study or recreation after he has done his day's work in company with the sun. The great achievements of the artist and artisan are not in obscurity after sunset, but are to be seen by night as well as by day.

If some great genius could evaluate the possessions of mankind, artificial light would appear conspicuously in his report and doubtless would rank very high in importance and value. Among man-made things, perhaps it would rank first in value. In the production of light, man's early efforts resulted in light of an orange-red color. The incandescent lamp industry began with the carbon filament lamp in which a hair-like filament emitted a deep yellow light. As the industry developed through the combined efforts of many individuals engaged with various allied problems, the temperature of the filament has increased, the light has become whiter and the efficiency has been multiplied many times. Each improvement has resulted in a slight step toward artificial daylight. Today the efficiency of the lamp is so much higher relatively than those efficiencies of older lamps to which the pocket-book had become accustomed that it is practicable to convert the light into any quality or color which necessity or esthetic taste demands. The last steps in finally reaching the objectives have been made by temporary expedients—by the development of colored filters which convert raw light into light of more desired qualities. These ends will perhaps be reached some day by more direct methods. Eventually scientific discovery will perhaps give us a practicable lamp which emits artificial daylight directly from the light source and others which meet various esthetic and psychological requirements.

Imagination is indeed dead if it is not awakened by a retrospective view of the development and importance of artificial light, and of its contribution to the progress of mankind.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

How to Build Soil

To the Editor of the SCIENTIFIC AMERICAN:

In C. H. Claudy's article in the SCIENTIFIC AMERICAN on the French problem of reconstruction and referring to the damage to the soil resulting from shell fire, he says that "a shell which explodes beneath the surface of land, churns it up, buries the top soil and brings earth to the top which will not grow even a weed."

While I hesitate to question this statement which has been made by Mr. Claudy and many other writers, nevertheless, it at once occurs to me that it may be possible to bring the soil back by planting sweet clover.

Until recently, the value of sweet clover as a soil builder was not fully appreciated, but its use is now becoming more general in the United States. There is not much question that sweet clover will grow under conditions to be found on many, if not, all the battlefields of northern France, for, as stated in one of our Government publications, "sweet clover will make a good growth on soils too depleted in humus for profitable crop production." It has been said to have been used to enrich the subsoil excavated from canals and deposited along the canal banks.

If sweet clover will grow on the battlefields, this will be a remedy for at least some of the destruction which has been brought about by the war. In addition to the growth and the production of valuable forage, the sweet clover roots will add much humus to the soil, and in common with other legumes, it will enrich the soil with nitrogen.

Sweet clover will not only grow under very adverse conditions, but it will furnish nutritious pasturage, rich hay and valuable silage. Sweet clover is also of the utmost value as a source of nectar for bees.

EVERARD B. MARSHALL.

New York, May 2, 1919.

Farming for Returned Soldiers

To the Editor of the SCIENTIFIC AMERICAN:

Your Secretary Lane makes it clear, in his article in your issue of November 9th, that there are farms enough to go around among the returned soldiers, so far as the mere matter of land is concerned; but he does not enter into any explanation of how the soldiers are to be asked to farm them. The great and important question of soldier settlement is right up to us today, demanding our best thought and attention. Yet so far as I have been able to note it is being approached, on both sides of the world's most peaceful frontier, in but a half-hearted way, and from the wrong viewpoint entirely. I have recently written to the *Ottawa Journal* upon this subject, and am taking the liberty of putting the views then expressed before you, with the hope that you will circulate them among your broader audience.

So far as I have observed, all the schemes proposed for the settlement of returned soldiers, including certainly the one finding official acceptance in Canada and presumably the one Secretary Lane has in mind, are simply modifications of the old system of farming—or at best attempts to graft innovations thereon. Yet this system is by far the most expensive and extravagant one that could possibly be adopted. I can conceive of no plan that would be more wasteful of time, labor, buildings, and the equipment necessary to carry on the business of farming; and yet the effort is being made to induce the returned men to accept these methods.

As a rule, at the present time each farmer has his own set of buildings, machinery, horses, cattle, and the necessary paraphernalia or as much thereof as he can afford; and should he be fortunate enough to have sufficient help in the family he worries along. I venture to say that on every three average successful farms of 100 acres each there would be found sufficient machinery and other necessary equipment for the successful working of 1,000 acres—with the possible addition of one team of horses or one tractor.

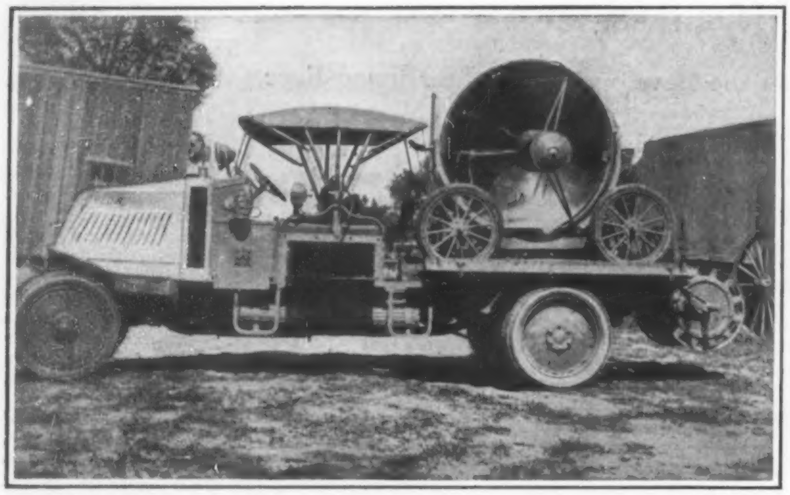
The time the farmer wastes in marketing his products, and the methods employed, are worthy the most serious consideration. In this same period, with more efficient methods, he could quite as well market ten times the quantity.

The same arguments regarding waste of time hold good with respect to the work around the buildings—chores such as milking, feeding, cleaning of stables and general care. These must be attended to daily; and at present the farmer is tied hand and foot to his farm and forced to neglect other matters of importance, to his frequent financial loss. No wonder the young people flee to the city with such umanimity! And this, or a modification thereof, is the scheme that we are apparently going to ask our returned heroes to take on in order that they may earn their own living and help to bear our burdens.

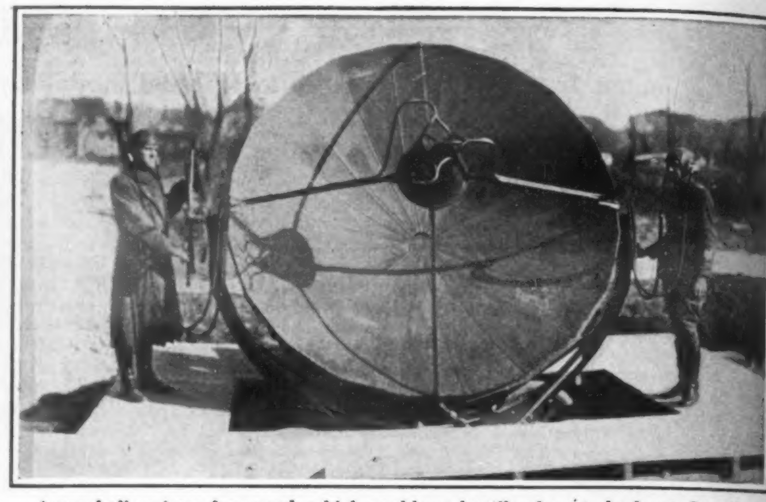
This prospective advent into the farming game of a great quantity of new farmers, who will farm new lands, should be seized, not as a mere incident in the extension and perpetuation of the old, old system, but rather as a golden opportunity to install a new one. All the great industrial and national undertakings succeed in direct ratio to the measure of intelligent coöperation with which they are prosecuted. It is suggested that a great effort should be made to utilize the creation of farming communities of returned soldiers for the introduction into agriculture of these same benefits. The details of a comprehensive scheme of coöperative farming and coöperative marketing are far too numerous and intricate to be worked out in a letter to the Editor; but without doubt the men who had the sand to drive out the unspeakable German would be well able, with necessary and competent supervision, to arrange such details to their own satisfaction, benefit and advancement—and, let us point out, at the same time to the benefit of all the rest of us.

A. H. HAWKINS.

Ottawa, Can.



A light-weight portable searchlight of great range used in anti-aircraft defense, after the attacking plane has been located by sound



A parabolic mirror for sound, which enables a hostile plane to be located on the darkest night, and at surprising distances

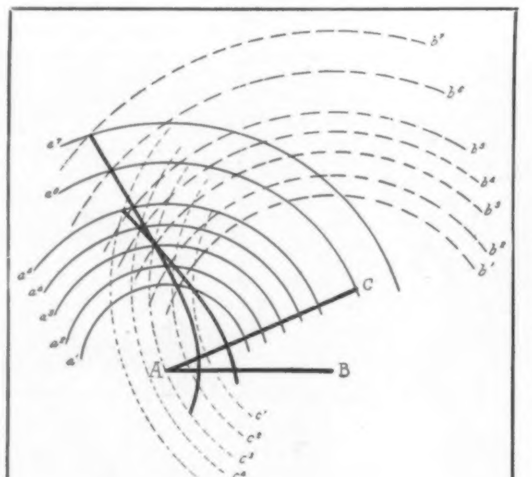
Listening for the Enemy

Sound-Ranging Devices Employed to Locate Hostile Guns, Planes and Submarines

IT may be taken as a maxim of modern warfare that, wherever the enemy is and whatever he is doing, he will make a noise in doing it. If he is firing a big gun at us from fairly near by, or if he is flying over our heads on a dark night with a cargo of bombs, we will hear him with our unaided ears; if he is farther away or engaged in a comparatively silent activity like submarining, we may need to use artifice to bring him above the threshold of audibility. But in any event, whatever the circumstances, rest assured that we can hear him.

In the effort to take advantage of this situation both parties to the late conflict exerted their ingenuity early and late to develop apparatus and to improve methods of sound-ranging, on land and in the air and at sea. The first place where the art of locating the foe by listening to him was brought to a fair state of perfection, was in searching for distant and concealed batteries. Without developing any elaborate apparatus, a little ingenuity in the practical application of a very simple mathematical principle made it possible to locate concealed guns with a very decent degree of accuracy. Since the principle involved is more or less general to all sound-ranging, it may be worth while to look into it with some fullness.

Suppose we have two observers stationed at A and at B, 4,000 feet apart, and connected by telephone. Let them be provided with apparatus of such design that when a gun is fired they can ascertain the precise interval of time that elapses between the receipt of the sound at their respective stations. Suppose that it were thus established that observer A hears the report two seconds before observer B. Since sound-waves travel some 1,150 feet per second, this means that the gun is 2,300 feet nearer to A than to B.



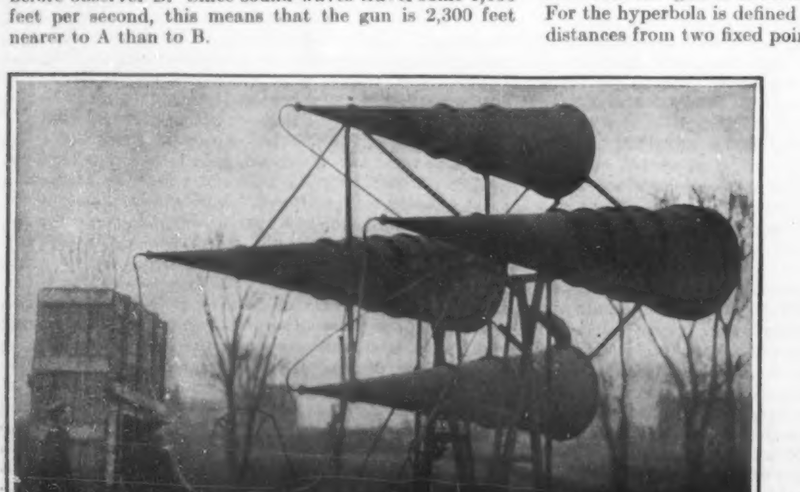
How a gun is located by timing its report as heard at three points

If the mathematician were now called in, he would point out that the conditions determine a hyperbola, and that the gun is located somewhere on this curve. For the hyperbola is defined as the locus of points whose distances from two fixed points differ by a fixed amount. Moreover, if we are given these fixed points and this fixed difference, the hyperbola is completely determined, and can be drawn. The mathematician would prefer to say that its equation is determined, but the artillerist goes right ahead and draws the curve, without bothering his head over the equation.

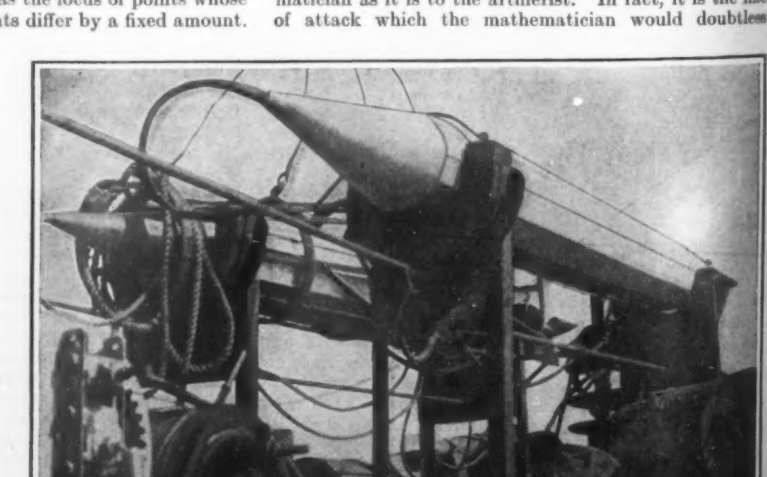
With A as center, he draws a series of circles a_1, a_2, a_3, etc., with any convenient radii—say 1,000, 1,250, 1,500, . . . feet. Then about B he draws another set of circles b_1, b_2, b_3, etc.; only this time he takes each radius 2,300 feet greater than the corresponding radius of the first set. Each circle of the first set then intersects the corresponding circle of the second set in a point that is 2,300 feet nearer to A than it is to B. All of these points are on the hyperbola; any one of them might be the location of the gun sought. When all of them are joined by a smooth curve, that curve is the hyperbola, and the gun lies somewhere on it.

Using the same method to determine the time-difference between the receipt of the sound at A and at a third station C, a third set of circles can be drawn about C, with appropriate radii. If the report reaches C one second after it reaches A, for instance, the circles c_1, c_2, c_3 . . . will have radii 1,150 feet greater than the corresponding radii of the circles about A. The intersections of the circles about A with those about C give us a second hyperbola, upon which also the gun lies. But every high-school student knows that if it lies upon both hyperbolas it lies at their intersection; so that when both curves have been drawn, its position is fixed.

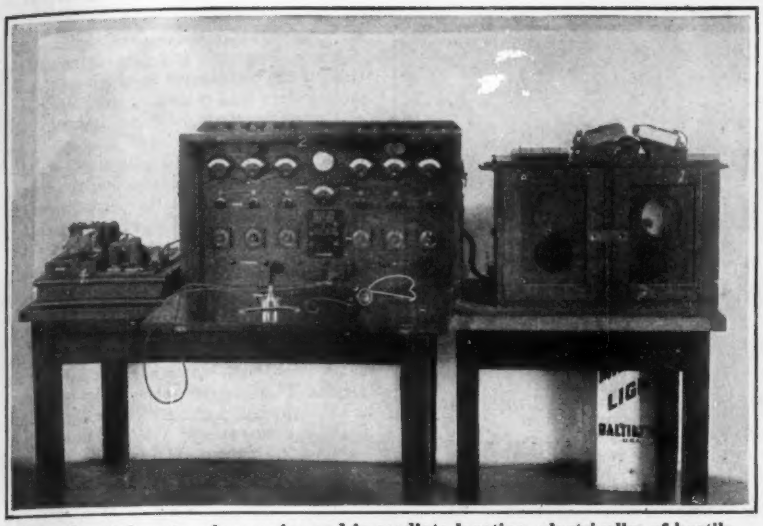
This procedure will be as satisfactory to the mathematician as it is to the artillerist. In fact, it is the line of attack which the mathematician would doubtless



Long-horn set used by the French in locating enemy aircraft



A British hydrophone operating on the principle of angular divergence



The phonotelemeter, for precise and immediate location, electrically, of hostile artillery by means of the sound emitted

employ if some heartless wretch were to suggest that after getting the equations of his two hyperbolas, he actually proceeded to construct the curves. It is sufficiently accurate for all purposes—we control this feature by making the circles as close as need be. Accordingly, as soon as the graphical work on the problem has been completed, and the location of the hostile gun put into the language of the day for the benefit of the friendly gun crews, the latter can proceed to drop their unwelcome billets-doux upon the critical spot.

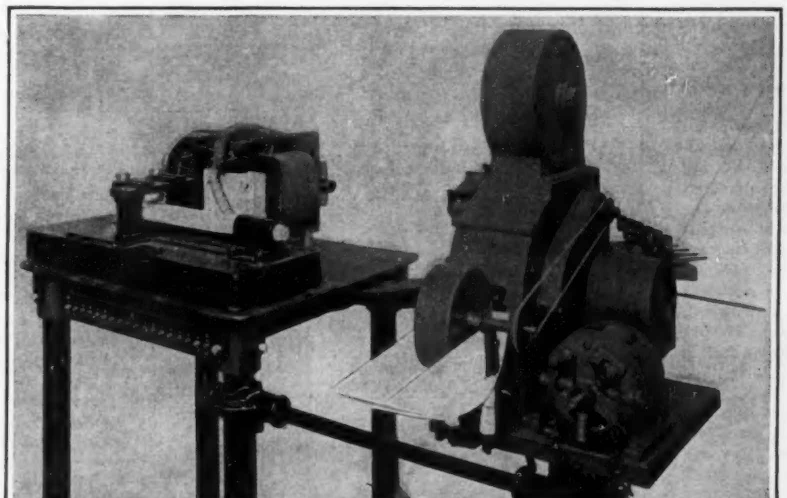
It will be observed that in theory the method is the simplest; but naturally there arise various difficulties in practical work. Apparatus must be of strong make-up, but sufficiently sensitive to secure accurate timing. Then a given sound must be distinguished with certainty out of many others, and the report or detonation must be kept distinct from the sound of the shell flight. Allowance has also to be made for the effect of wind velocity upon the travel of sound, and for other factors. But in spite of all this the method was reduced to successful practice at a comparatively early date—the more so because of the possibility of averaging a number of trials for the time-difference, and again averaging a number of indicated positions as obtained from various combinations of listening posts.

The method was found especially useful for locating batteries that had been successfully camouflaged. Against this the enemy uses various artifices to hinder accurate work. For instance, he fires at a carefully worked out distance other cannon which produce false detonations; or he fires at exactly the same instant a number of guns at various ranges. While it is possible partly to meet these and other hindrances, it is not easy to do so, and it is not possible to checkmate them altogether. On the whole, the margin of error which they introduce into the work is an uncomfortable one; and the electric detector was born in the effort to reduce it.

In turning to this, the sound-rangers were hardly treading untrod ground. Always there had been circumstances under which the distance of a hostile outfit might be too great to permit satisfactory returns by the unaided ear; or the enemy may be operating in something, like an airplane or a submarine, that merely makes a noise as distinguished from a report. Then it is necessary to have apparatus for receiving the sound, and perhaps for magnifying it as well. And it is immediately found that when any extended mechanical equipment is necessary for its reception, the matter can be simplified by incorporating a device that will at least indicate with accuracy the direction, if not the distance.

One field in which a good deal of attention had always been given to this style of automatic sound-reception was that of anti-aircraft work. We illustrate a set of horns designed for this purpose by the French, and likewise a wholly unique apparatus got up by the American engineers when it was established that the unaided horn left something to be desired in the line of accuracy. The student of optics will tell us categorically that the maximum efficiency is to be got out of a parabolic reflector; so the acoustic engineer was following a pretty definitely marked path when he built his sound detector in that form. The particular parabolic sound-mirror which we show will pick up the hum of a hostile airplane at a distance equal to three and one-half times the greatest range of the human ear; it is extremely light, and portable to the last degree. Then, to complete the tale of what happens to enemy planes that are out of luck, we show the portable searchlight which travels with the sound-ranging outfits for the purpose of illuminating the pests of the night and making it possible for Archie to take a shot at them.

The hydrophone is to all intents and purposes the same sort of instrument as the parabolic detector, except that it works in a denser and therefore a more favorable medium. It picks up the sound waves that arise from the propeller of a hostile submarine and travel through the water, and it makes these audible to the human ear; in addition,



The recording tape, galvanometer and tuning-fork timing apparatus in the phonotelemeter

in one way or another, as already described in these columns, it indicates the distance, or the direction, or both, of the source.

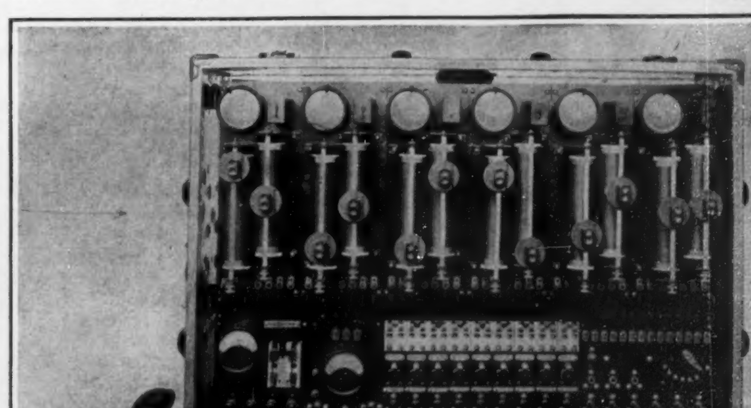
Given such efficient aids to location of the enemy as these, it was but a step further to the utilization of the valuable sound-detection powers of electricity. One of the most effective instruments of the entire sound-ranging campaign was the phonotelemeter, another American development. In this apparatus the dual reception principle is again employed; only here the two points of impact for the sound are so close together that without the electrical features of the device, no distinction could be made between the moments at which the sound reaches them. But the assembly includes a tuning fork which is kept in motion electrically; and its successive strokes divide a second so accurately into so many parts that it is a simple matter indeed to secure a graphic record that combines the strokes of the fork and the impact of the sound upon the two diaphragms, and accordingly shows just how many thousandths of a second elapsed between the two impacts. This, in combination with the well known principle that the sound is loudest in a microphone when it falls perpendicularly upon the diaphragm, makes it a matter of comparative ease to get up an instrument which will reveal in a moment the precise distance and direction of any source of atmospheric disturbances. Indeed, the phonotelemeter is credited with having spotted 117 hostile guns or batteries within a period of 24 hours—all on the five-mile front which is covered by a single instrument.

The technique of sound-ranging is a vast improvement over older methods of locating hostile points of fire, mainly because it does not require such extensive data. This necessity for sufficient data is quite generally overlooked in reports that get printed in supposedly reliable organs. Thus, all the daily papers carried, in the spring of 1918, a tale to the effect that the big German gun that bombarded Paris had been located in the St. Gobain Forest by reconstruction of the trajectory when the shell passed through a double awning. The holes, it was gravely stated, were perfectly clean-cut; they were measured with excruciating care and the exact direction of their line of centers was found; and from this "the French artillerists were able to follow back the course of the shell to the mouth of the cannon."

With all due respect to the gentlemen who accepted this yarn, it is of course an absurd one. If the French authorities had had advance notice of the fact that one of the German shells was to pierce this particular awning, and had there set up the usual electric device to time its flight through the space between the two members, the striking velocity would have been known as well as the angle of fall, and the process outlined in the story could then have been carried out with more or less accuracy. But in the absence of data as to remaining velocity, of course, nothing of the sort was possible.

The yarn is, in fact, a familiar one. The first time we heard it, it was got up in a form calculated to extol the wonderful ability of the Yankee. An American artillery officer was reported as having been travelling along a camouflaged road, when a shell pierced the burlap roof above him and struck at his feet with a thud and an explosion. Notwithstanding that the shell's refusal to turn out a dud prevented the worthy gentleman from even recognizing its caliber and thence its initial velocity, he at once estimated its angle of fall from a glance at the hole it had torn in the camouflage, performed a few mysterious calculations—whether in his head or on his cuff was not specified—and telephoned the location of the offending piece to the nearest battery.

Naturally, this whole tale is even more ridiculous than that from Paris. If a gun is to be located promptly and accurately, sound-ranging will have to be used. This is the only method that makes it unnecessary to know anything about the gun itself—its caliber, for instance.



An installation similar to the phonotelemeter but less portable and more rugged

Can a Safe Airplane Be Made to Sell at a Low Price?

THE airplane is an inherently expensive machine. Occasionally one reads in the daily press that airplanes are soon to be sold at a few hundred dollars each, or at a price comparing favorably with a good motorcycle. But such statements are based on imagination rather than fact; some enthusiastic writer, so it seems, has allowed his imagination to get ahead of him.

Since the termination of hostilities various aircraft manufacturers have turned their attention towards commercial aviation. Here and there small single-seater and two-seater commercial airplanes have been introduced, ranging in price from $2,500 to $5,000, as well as larger three-passenger winged limousines selling for $10,000 or more. So far, it appears that $2,500 is about the lowest price for an airplane that is really practical.

This single-seater monoplane is one of the latest attempts to build commercial airplanes at a very low cost

No doubt there will soon be airplanes on the market for as low as $500, but unless some distinctly new principle of construction is called into practice, such machines will hardly be safe to fly. To be really practical, an airplane must have a sufficiently powerful motor to buck strong winds, and must be so constructed that the motor is ahead of the pilot. There should also be provided a staunch landing gear, in order to take up all shocks including crashes to earth.

The accompanying illustration serves to show a form of inexpensive machine which is decidedly dangerous. In fact, there is nothing distinctly new about it, for the reason that a very similar construction was followed in Santos Dumont's "Demoiselle" monoplane, which was flown to some extent in 1909 and 1910. In the present machine, which has been designed to provide an inexpensive airplane for the general public, it will be noted that the V-cylinder engine is placed above and somewhat ahead of the pilot, who sits in a small nacelle below the wings. The landing gear consists of an axle and a pair of wheels, directly fastened to the front of the nacelle. In the event of a hard landing there is absolutely nothing in this machine to take up the shock, such as resilient V-struts as in most machines, and there is nothing to prevent the engine from crashing onto the pilot. The only feature in favor of this machine is its low price, which is necessarily far lower than those machines of the regular biplane tractor design.

So it follows that an airplane can only be sold at a low price if the fundamental principles of safety are set aside. Indeed, it is very much feared that as the public turns more and more to everyday flying, there will be numerous fatalities due to the use of machines that are poorly designed and cheaply constructed.

A "Super-Charged" Airplane Engine

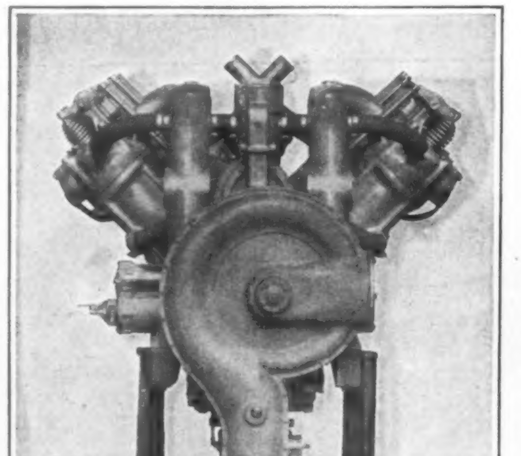
By Benjamin S. Foss

UNDER the stimulus of war, the use of the airplane has been marvelously extended, not only horizontally, but also vertically. High altitude flying has become the rule rather than the exception, and as a consequence, the difficulties which confront the aviator in these altitudes have become acute. These difficulties in turn have been passed on to the aeronautical engineer, and serious study has been made with the view of solving these highly technical problems.

As is well known, the limiting factor to high altitude flying, is the rarified atmosphere, which adversely affects the engine quite as much as the pilot. The density of the atmosphere decreases progressively as one ascends and causes the engine to lose power, until at approximately 20,000 feet, the engine develops but 50 per cent of its horse-power at sea level. Moreover, to compensate for the lack of support offered by the rarified atmosphere, the speed of the airplane must be increased materially. This increased speed cannot be obtained on account of the lowered power of the engine. These factors determine the maximum altitude, known as the "ceiling," of the airplane, above which an airplane of given power and load cannot rise.

Could the power of the engine be maintained at these high altitudes, not only would the ceiling of the airplane be greatly extended, but greatly increased speed would result, on account of the decreased resistance which the thin atmosphere offers to the passage of the airplane.

This problem of maintaining the power of the engine at high altitudes is one that has absorbed the energies of engineers for several years, and various methods have been employed partially to overcome this difficulty. These have included the admission of oxygen to the engine, compensators for the carburetor, auxiliary air intakes, high compression pistons, etc. At best, it may be said that these devices have only partially solved the difficulty, and are temporary expedients, pending the development of an engine which will maintain a constant power output, irrespective of altitude.



This blower, attached to an airplane engine, permits of efficient operation at high altitudes

For a long time it has been recognized that, if the air density at the intake of the engine were held constant, the horse-power of the engine would be maintained. The physical properties of the atmosphere remain the same at all altitudes, it being merely a question of increasing the density to approximately sea-level conditions, to maintain the sea-level power of the engine. This is a question of forced draft.

The difficulty of applying forced draft, as it were, to the engine has been to develop a device sufficiently large to furnish the volume of air necessary, capable of producing the required air pressure, and at the same time, light enough to be used on an airplane. Moreover, the means of operating this device has been a controlling factor, inasmuch as variable speed is desirable to vary the air pressure and volume according to changes in altitudes and atmospheric density.

The mechanical requirements of this problem demand a high speed rotary blower, driven by the airplane engine, and discharging its air into the intake of the carburetor. By varying the speed of this blower according to altitude, the air entering the carburetor can be kept at an equal density, approximating sea-level conditions, thereby obtaining constant engine power at all altitudes.

Two obvious means of driving this blower present themselves, one by mechanical connection to the engine through belts, gears, etc., the other, by a gas turbine using the engine exhaust gases. Both of these methods have their advocates, and experimentation and development has proceeded along both lines.

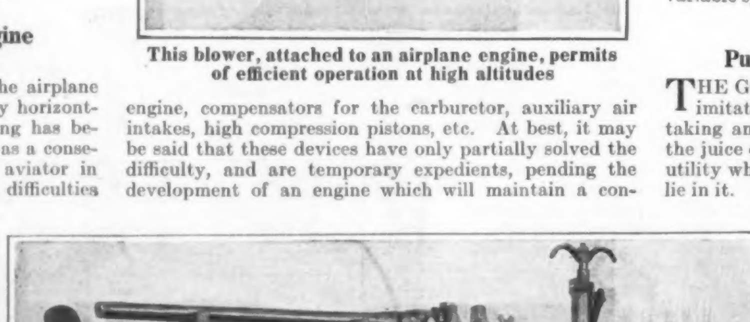
At the recent Aero Exposition in Madison Square Garden, a prominent American manufacturer exhibited a rotary blower, mounted on a well-known type of airplane engine. This blower is the result of two years' development and test on the part of the company's engineers, and now for the first time was publicly shown. The device, which is called a "super-charge" fan, consists of a high speed rotary blower, mounted on the engine bed and driven by the engine, through a variable speed mechanism. The blower consists of a fan wheel, cut out of a sold billet of steel and enclosed in a spiral aluminum housing. The fan is mounted on ball bearings and driven through a chain of gears with final belt connection to the engine. It operates at 10 times engine speed, approximately 15,000 revolutions per minute. It is stated that the fan will deliver a pressure as high as 14 pounds per square inch, which performance is certainly unusual in a single stage fan of this description.

The blower is entirely automatic in operation and is controlled by a barometric device connected with the variable speed drive, whereby the air pressure is increased

(Continued on page 524)

Pulling the Trigger by Fluid Pressure

THE German has been shown up by the late war as an imitator rather than an inventor. His forte lies in taking an idea from some foreign source and squeezing the juice out of it until it gives up an amount of practical utility which its conceiver would never have supposed to lie in it. And by the same token, when anyone develops an idea which baffles the German, he has done something of which he may well be proud. The Germans took over and improved the submarine and the machine-gun and a host of other British and French and American inventions; but there was one little invention, which first saw the light during the war, and which Fritzie never was able to use—apparently for no other reason than the very good one that he couldn't figure out how it worked. This was a device, weighing but a few pounds, known to the initiated as the "C. C. Gear." It was this gear which gave to the Allies a goodly portion of their indisputable mastery of the air, and was thus instrumental in bringing the war to a more speedy close.



The gear for shooting between the blades of the propeller by means of fluid pressure, showing all the working parts

This device is far from being a complicated one. Contrary to the impression which has been allowed to go abroad, and even to some extent to prevail among the Allied airmen themselves, it involves no new principle, no factor of mystery whatever. It contains no intricate mechanism, operating merely by pressing a button or lever. Yet it successfully defied solution by every noted scientist of Germany and Austria for a period of two years during which samples of it were continually

falling into Boche hands on captured planes.

The term "gear" as used by pilots of the air signifies a mechanical device by means of which a machine-gun may be timed to fire between the fast revolving blades of a propeller. There are more than a few of such devices; the one most used at the time when the idea first gained acceptance was illustrated in these columns a couple of years ago; but the C. C. gear differs from all the rest in the fact that it is non-mechanical. The tremendous advantage of this will be realized when it is remembered that the terrific speed at which it must operate necessitates the timing of the gear to fire accurately 700 shots a minute through a two- or four-bladed propeller revolving 2,000 times a minute.

The history of the gear is romantic in the extreme. When the war started in 1914 no one beyond the novelists of perfervid imagination had any idea that aerial combat would develop to any great extent. The first pilots were chivalrous fellows. A Hun flier darting past a British or French machine would wave his hand genially, and receive a cheery salutation in return. Airplanes were solely for reconnaissance purposes.

Then, one day, a Hun, with villainous intent, pulled out a revolver and took a pot shot at a Britisher. The Englishman was surprised; he hadn't thought of that. From that time the war in the air was on; revolver duels became common enough. No one was ever hit, but it was good sport. Even when a British pilot endeavored to make the game a bit more exciting by taking a shotgun aloft with him, and when the Huns retaliated, these weapons were found to be little more dangerous than their predecessors—though it is on record that one enemy machine was thus brought down.

Eventually a pilot, more daring than the rest, conceived the idea of using a machine gun. The Lewis, being light and exceedingly mobile, was the first choice. It was a great improvement, and all parties concerned recognized it as such from the first. Planes began to carry machine guns as a matter of course; and the only drawback was the limited area in which the gun could be fired—only at right angles to the direction in which the machine was flying, in the majority of instances.

One day a pilot took a chance and fired straight ahead through the propeller. It was a risky proposition; but on landing it was found that comparatively few of the shots had hit the blade—about four per cent to be exact. It was, however, expensive as well as dangerous, with propellers costing $100 and more. So the next step was to armor-plate the blades so that the bullets would glance off. But this threatened to put a stop to formation flying, because the bullets, ricocheting in all directions, were as much of a menace to friend as to foe.

One summer afternoon, three years ago or thereabouts, a flight commander on the western front was surprised to hear a Hun plane overhead rattling off bursts of 40 or 50 shots with surprising ease. A pilot was sent up to bring the stranger in, and by great good luck he succeeded. When the Hun was shot down it was discovered that a novel contrivance of rods and levers had been fitted to the engine synchronizing the firing of the gun with the revolutions of the propeller, thereby making it altogether safe to fire through the rotating blades. It was at best a crude contrivance, but a vast improvement over indiscriminate fire.

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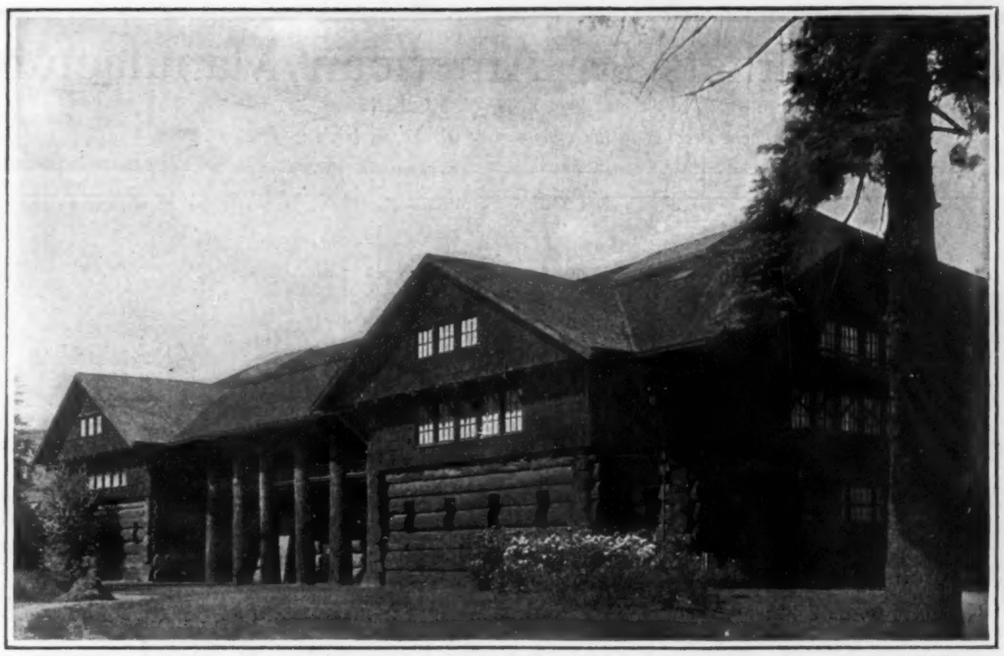


The largest log house in the world, built as a monument to the lumber industry of the northwest coast

A Log House of Colossal Proportions

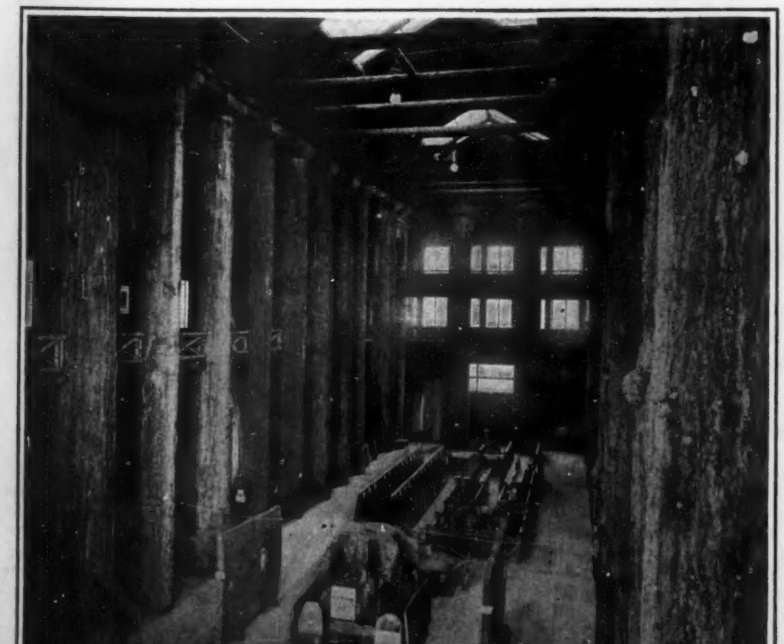
THE American penchant for superlatives is so well known that it can fairly be said to constitute a national characteristic. It is our thoroughly fixed custom to take serious notice only of things or of achievements to which the superlative can be attached. To the biggest or the heaviest or the fastest or the tallest thing of its sort we give the respectful attention of at least a passing moment; upon the second biggest or heaviest or fastest or tallest we have no glance or thought to waste. So perhaps we may without further apology ask the busy reader to pause long enough to gaze upon the counterfeit presentment of the largest log house ever constructed, which has recently reached completion at Portland, Ore.

This is in more senses than one a monumental edifice, since it is put up to commemorate the timber and lumber industry of Oregon, with special reference to its part in the great war. It is therefore most fitting that it should take the form of a huge structure of logs. Huge in very truth it is: 206 feet long, 102 feet wide, 72 feet high. There are 64 pillars, each 54 feet in height. More than a million board feet of lumber were used in the undertaking.

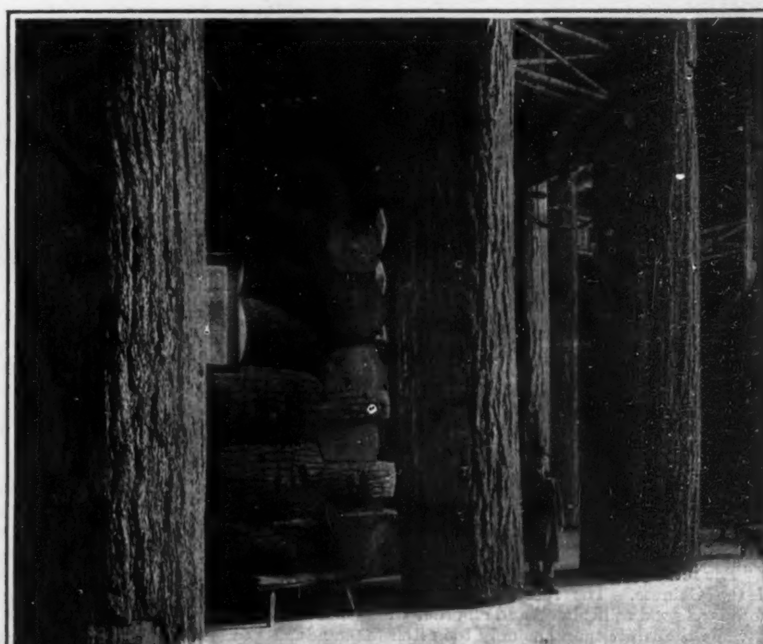
The building is constructed altogether of the huge fir logs that constituted the chief raw material for the emergency wooden fleet. Perhaps, better than any figures, the photograph showing a man standing at the foot of one of the pillars conveys an adequate impression of the size of this monument to the workers of the woods and their achievements.

Discovery of the Influenza Germ

AN account of the discovery by Major H. Graeme Gibson, Major Bowman, and Captain Connors of the Allied army medical services, of what is stated to be very probably the causative germ of influenza appeared lately in the *London Times*. The germ belongs to the order of filter-passers and is grown by the Noguchi method. The discovery cost Major Gibson his life, as he fell a victim to the very virulent strains of the germ with which he was experimenting.



The impressive vista through the main hall of the log house monument



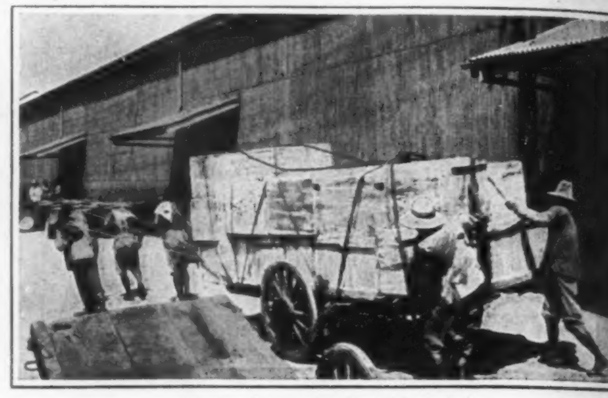
An advantageous view of some of the huge log pillars

World Markets for American Manufactures

Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

A gang of coolies unloading box cars at Shanghai



A man-drawn truck at Shanghai

The Travels of a Trader

"THE old Yankee horse trader's knack for swapping is one of the greatest needs in extending the sale of American goods abroad," said a prominent Chicago merchant recently. "If the men in charge of our branch banks in foreign countries display ability of that sort, good care will be taken of our commercial interests. Our future business with one-third of the people of the world, who live in China and Russia, depends upon the development by American firms of a satisfactory system of barter—the exchange of our manufactured goods for their various products.

"We shall have to handle our trade with those countries, and with many others, just as the general store in the small town is conducted. One customer pays for his purchases with so many bushels of corn or so many barrels of apples; another, with so many cords of wood. For many years I owned a store of that kind, and my business grew into an international enterprise because ordinary commercial principles were observed and applied. The better you know a customer, the more you can sell to him and the more you can sell to his friends. You have to give him what he wants when he wants it; if he can't pay cash down you have to be reasonable in the matter of credit. When your customer knows that he can buy from you anything he needs, at a fair price, and that you won't try to 'do' him, he will not only spend plenty of money himself, but also bring his friends to your store.

"Why don't more American firms seek foreign markets? One reason is that too many 'bosses' like to boast of never having taken a vacation. They sit too tight on the job and grow in rather than grow up. After 20 years' hard work I let one of my friends, a sea captain, persuade me to take a trip to China. Up to that time my firm had not received a foreign order. We were selling goods all over the United States and in Canada, but we had no overseas trade.

Different Ways of Doing Things

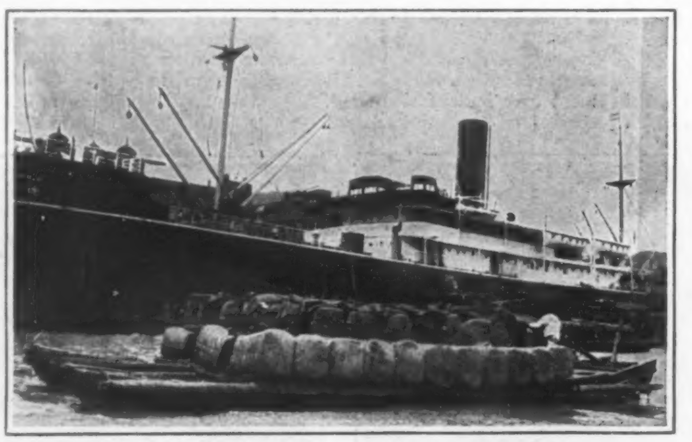
"We landed at Shanghai and there I met John Chinaman on his native soil. He does everything with 'reverse English.' For instance, he writes his name 'Chinaman John'—the surname comes first. In a Chinese book the words run backward, according to our point of view—they read from right to left. A Chinaman who wants to sell something to you or buy something from you invariably insists that you are a better man than he is; a richer man, of much higher standing in the community; a 'number one' man! All of which means that you can pay the top-notch price, or accept the rock-bottom price, according to your position as buyer or seller.

"The retail trade of China will always be in the hands of the Chinese. The reasons are that a Chinaman's word is as good as his bond and all other Chinamen know it, while the white man has only too often taken advantage of his Chinese customers; and that individual sales are too small to return the large profits necessary to satisfy the foreigner. I visited one shop where the sales ran as high as one hundred daily, and yet the receipts did not total more than $7.50 on the average. The proprietor thought he was doing a good business. There are thousands of similar establishments in China.

"The vast extent of the Chinese market makes it an unrivalled field in which to sell a low-priced article of universal use. An American oil company increased its sales of kerosene in China by distributing large quantities of simple little lamps, each marked with a good-luck symbol in the proper color—red. So great was the demand for them that one importer in Hankow offered to take the entire initial consignment. This shows the importance of attending to details.

The Sunrise to Sunset Limited

"In company with the representative of an American machinery firm I took a train from Pekin early one morning and journeyed through North China. About dusk we came to a place called Shanhaikuan, where all passengers were discharged. Now, both of us were going on to Harbin, in Manchuria, and we naturally expected to find another train waiting; but there wasn't any. No trains were operated at night on account of the dragons! So there we had to remain, bag and baggage, until dawn, when transportation again became available.



Native lighters alongside ships in Shanghai Harbor

"Speaking of Chinese railroads reminds me of the failure of an American manufacturer to obtain a contract for locomotives because his European competitors made a more careful study of Chinese peculiarities. One locomotive was ordered from each of the competing companies. In every respect save one, the American product was unmistakably superior. However, it had been painted black before shipment from the works and on the way across the Pacific it became more or less rusted. Its appearance, therefore, was far less attractive than that of the European locomotives, which were painted in accordance with Chinese preference, and had been touched up by the manufacturers' agents after arriving in China. Don't get your colors mixed if you want to sell goods to the Chinese.

"At Mukden we changed to the Japanese railways—and it was like jumping right back to the United States. A regular American passenger train, drawn by an American locomotive and consisting of American chair cars and sleeping cars, was a welcome sight to a weary traveler. The only difference was a Japanese porter in place of the bowing negro who angles for your loose change while you are enjoying like comforts in the United States.

Siberian Philosophy

"From what I saw in Siberia, and later in Russia, I am sure that food is the best remedy for the present chaos in that great expanse of territory. The people are docile enough ordinarily; if they have enough to live on they are quite satisfied. During the Czar's regime the Russian peasants hesitated to raise wheat, for the tax collectors took three-fourths of the harvest. When the Russians do succeed in accumulating a little money they hasten to spend it; the faster it gets out of their pockets the happier they seem to be. One trader who had gambled away the earnings of several months seemed not to be worrying over his misfortune. 'The tax collector would have taken most of it anyway,' he said.

"That, of course, was before the great war. Conditions have changed since 1914, but the character of the people is the same. Much of the trade throughout Russia was carried on by German firms prior to the war. The commercial language in widest use is German. When order is restored it will be up to the Yankee horse trader to sell American products, which must be exchanged for Russian products to be sold in the United States. The Russian merchant will not, for a long time, have sufficient capital to enable him to buy American shoes, let us say, f. o. b. New England factory. Then the lack of a medium of exchange must be remembered. Russia is flooded with paper money of little or no value, and no one will venture to predict when its currency will become stabilized.

"As the result of my trip we organized an export department, beginning our sales campaign in the countries that I visited. Since then other members of the firm have gone to other parts of the world to get a line on markets and methods. It has been our policy to see for ourselves and find out what's what before attempting to enter strange fields. You might call it the 'general store' system applied to foreign trade—knowing your customer, giving him what he wants, and swapping if he'd rather swap than pay cash. Our foreign agents take care of the bartering part of it."

Selling Woodworking Machinery Abroad

"THERE has been a lot of talk about the vast number of temporary dwellings required to shelter the homeless people of devastated northern France and Belgium," remarked a machinery manufacturer. "It has been said that a great deal of woodworking equipment will be needed to turn out the sash, doors, blinds, flooring and other parts of these houses. A representative whom we sent to Europe informed us that the British and the French makers of this sort of machinery will probably obtain most of the business. American woodworking apparatus has been criticized in England because of its lightness, machinery obtainable for American wood not always being suitable for British wood, such as oak, elm, ash, beech and birch. A number of American lathes and planing machines are being used by Scotch woodworking firms. American small tools of many kinds, including chisels, gouges, saws and planes, are found in every important shop.

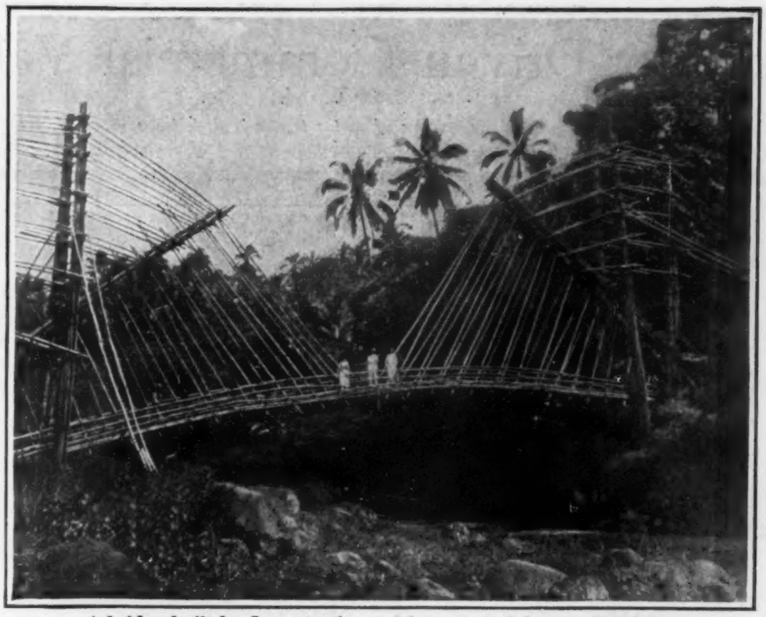
(Continued on page 526)

A Bridge Without a Trace of Metal

THE natives of Java have a bridge-building technique which utilizes to the limit their slight resources for work of this character. Of raw materials they are acquainted with but two, and one of these is really a product of their own ingunity. They have no nails, no iron, no true wood; they are forced to rely entirely upon bamboo for the structural parts, and upon a rope of their own manufacture to effect the junctures. In spite of these limitations, they achieve highly creditable results, as the photograph reproduced herewith will go to show.

This picture represents a bridge over a river in the central part of the island. The span is almost 150 feet, and the width of the roadway some four feet. The four bamboo columns at either side of the stream are built up of a double length of from 50 to 60 bamboos, tied up with rope and firmly pressed together by forcing a quantity of wedges between rope and bamboos. Such columns are found to be of remarkable strength and elasticity; they are, in fact, used throughout the Dutch Indies as derricks for lifting roof-pans when building sugar factories, etc.

The original element which the Javan natives have brought to the construction of these bridges, as remarked, is the rope. This is made of a fiber taken from the native aren-palm, which grows all over the island. This fiber, as shown by a sample placed in our hands by Mr. F. Karthaus of Djenar, Java, is of a black and horny substance. It makes a rope that resists effectively the heavy decaying action of the hot and damp tropical climate with its legions of fungi; in fact, it lasts for many years without any indications of rotting. So between this rope and the bamboo, the natives are able to achieve a semi-permanent structure for which it would be hard to find a peer on the ground of cheapness and durability. Perhaps the most surprising feature of the whole thing is the degree to which has been approximated the best type of bridge arch. How does an ignorant savage know that a bridge ought not be built perfectly flat?



A bridge built by Javan natives with no materials save bamboo and rope

Beauty and Utility Combined

IT does not often occur that beauty and utility can be obtained advantageously. But in Golden Gate Park, San Francisco, Cal., there have been erected two Dutch windmills, each of which serves the double purpose of a spectacle as well as a pump. These windmills, erected a few hundred feet from the Pacific Ocean, revolve a large part of the time, particularly during the summer season, when the winds are invariably strong along the coast. The water pumped from the ocean is used for irrigation purposes throughout the park, and also replenishes the numerous lakes scattered throughout this famous recreation center. As each of the four planes of the revolving wheel of the windmill is about 40 feet long and seven feet wide, the energy developed by the wind is enormous. This method of pumping water for irrigation purposes is not yet common in California, but the success of the experiment in Golden Gate Park makes it appear that the idea may well be copied elsewhere.

Windmill of pleasing outline in a San Francisco Park

Furniture for the Tropics

FURNITURE as well as other wood products used in the tropics is subjected to the attack of insects known as termites. This attack is excessive in South America in the coastal regions north of Rio de Janeiro, and is so certain and so severe that, in the opinion of the Forest Products Laboratory, it is useless even to think of exporting wooden furniture to those regions unless the wood used is naturally resistant to termites or is treated with a poison to prevent the attack of these insects.

There are a number of species growing in Brazil and other tropical regions which are naturally immune to termite attack and which are used in those countries almost exclusively for the manufacture of furniture. None of the cabinet woods which grow in this country, however, possess such immunity.

Of course, in order to compete with the furniture now used in these regions the United States product must be equally durable. One way of making it so would be to import cabinet wood from the region in question, make it up into furniture here, and return it. A similar practice appears to have been very successful among European furniture manufacturers before the war, when much of the furniture sold in Brazil is said to have been manufactured in Europe from Brazilian woods.

Another possibility that may be considered is the use of some of the cheaper domestic furniture woods for backs and cores, after thorough impregnation with a poison such as mercuric chloride, and the use of Brazilian termite-proof woods in the form of veneer for facing.

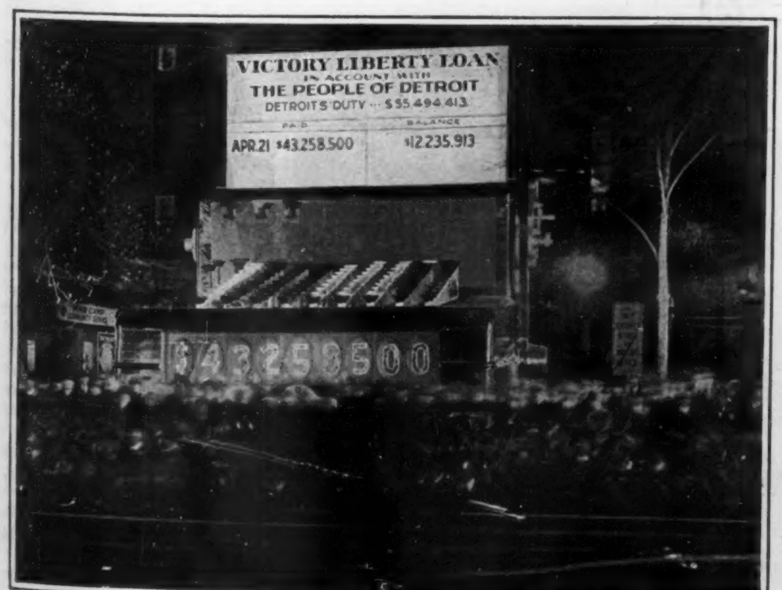
Totaling Victory Loan Subscriptions on a Monster Adding Machine

PERHAPS the most novel of the many ingenious mechanical and pictorial devices used throughout the country to stimulate interest in the various Liberty Loan campaigns was the giant adding machine on which Detroit kept a record of the Victory issue subscriptions.

This machine was set up on the front lawn of the city hall facing the busiest section of Detroit. It was 22 feet wide, 34 feet long and 12 feet high, and reached a total height of 22 feet at the back due to a raised base which tilted the big machine forward.

The keys of the monster calculator were about a foot in diameter and had the appearance of lunch counter stools. A ledger page 20 feet wide and seven feet high was shown in the carriage—and the entries on this sheet were changed every day during the weeks of the loan. The total subscriptions also were shown in glass panels at the front of the machine, representing the dials of the ordinary adding machine.

Detroit went "over the top" the first day with total pledges of $63,159,150, and before the campaign was over the adding capacity of the giant 9-column machine was taxed almost to the limit. Flood lights illuminated it at night, and helped to make it a most successful means of sustaining interest in the loan.



Giant adding machine on which Detroit's Victory Loan subscriptions were totaled. Size of machine 22 feet wide, 34 feet long, and 12 feet high

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Extension Rims for Sand

THE ordinary solid rubber tire used in motor trucks is a very satisfactory wheel tread for hard roads but it does not have sufficient area to keep the wheel from cutting into sand or soft soil. The device shown in accompanying illustration is a simple contrivance that can be attached to any truck wheel to prevent loaded trucks from settling down in soft roads or fields. If a modern Robinson Crusoe should suddenly come upon the tracks of a "sand growser"—equipped, California, orchard truck in the deep sands of his desert island, he would undoubtedly wrinkle his brow in perplexity and ask himself what manner of machine this could be—for the tracks would be neither those of an ordinary truck nor yet of a tractor. The deep impressions would have almost the breadth of tractor drive wheels but they would be also of two depths—"steps" on the sands of progress—and the desert island. The "sand growser" however, is now a reality in the orange groves of California. As will be noted from the illustration, this attachment consists of an "extension rim" on each wheel of the truck. When the wheels of the loaded vehicle begin to sink into the loose sand or soft earth of the orchard, the "growsers" reinforce the tires, doubling the soil resistance and traction surface. The rear rim extensions are furnished with sand lugs to give added traction when the going becomes hard and heavy. The auxiliary rims clear the road by several inches when traveling on a smooth highway. Trucks so equipped collect the fruit in the orchards (the truck in the illustration is bringing out over 4,000 pounds of oranges) and later haul the packed crates to the city markets. Mr. J. Reynolds, a newspaper man, a fruit grower of La Verne, Cal., is the owner of the "sand growser" reinforced truck shown above.

Motor truck equipped with extension rims to prevent wheels from sinking into sand

Electric Tower Wagon for Trimming Street Lamps

THE electric lamps along San Francisco's brightly illuminated Market Street are kept in order by the aid of a specially devised tower truck built by a gas and electric company for its own use. The uppermost lamp is about 35 feet above the sidewalk line. It is necessary to have a type of trimming device whereby a man can work safely and quickly on the lamp. The idea of this wagon was conceived by Mr. S. J. Lisberger, engineer for the company, from a short tower wagon used by the street railroad companies for working on their overhead trolley cables, which are usually about 21 feet above the ground. It was really only necessary to develop the collapsible lift for three sections as against two to increase the possible raising height from 21 feet to 25. This tower is mounted on a one and one-half ($1\frac{1}{2}$) ton electric truck. The battery that drives the wagon is also used to drive a motor that raises and lowers the platform.

Since the photograph was taken the company have mounted a vacuum cleaner on the platform which is also driven from the battery installed on the wagon, which vacuum performs the function of drawing the magnetite dust given off by electrodes while this lamp is burning. It was found that when the workmen endeavored to lift the dust pans out of the lamps the wind blew the magnetite dust all over the pedestrians, so the well known vacuum cleaner was put to a new use.

Electric truck used for trimming street lamps

It will be noted that the platform is mounted on a ring so it can be revolved in any direction, furthermore, that the railings on the platforms are collapsible. The battery gives current enough for testing the lamps on the circuits. The tower is provided with limit switches, so that all the operator has to do is to pull a rope and the tower starts to lower and stops automatically when it gets to either its minimum fold or its maximum lift. The truck weighs four tons and the springs are bolted down so as not to act, as the tower at certain places in Market Street where the gutters are deep and sharp, often stands at an angle of nearly 25 degrees and if the springs were free, the tower might sway to a point where it would be dangerous.

On the top of the upper sections of the tower is a platform, from which a horizontal extension can be projected when it is fully elevated, with which the trimmer can reach the highest lamp, which is approximately 35 feet high. This construction required hinged rails on top of the tower which must be raised and a board placed thereon to enable the operator to reach the top light, and these rails must be folded when the tower is lowered to enable it to pass under the trolley wires. The accompanying illustration shows the tower in use in Market Street. The batteries are recharged for four hours daily, one hour at noon and three hours at night. A second tower truck has recently been placed in operation to care for a lighting system extended throughout what is known as the "Triangle District" because of the successful service obtained with the first electric tower truck in this important work.

Long Distance Motor Transportation

THE problem of good roads is only one part of a bigger problem—transportation. It is necessary to state this obvious fact for the simple reason that the obvious is usually the last thing we see. The other half of the problem is vehicles, plus their motive power. Good transportation has resolved itself into two things: Good roads and motor trucks. A favorable sign of the times is the growing recognition on the part of good roads advocates that good roads exist for the use of better transportation media—the motor truck and the automobile. The motor truck is not only replacing horse transportation; but in many cases it is supplementing and supplanting railroads. The motor truck is the solution of the modern transportation problem.

In addition to the unlimited use of motor trucks for delivery purposes, they are substituting for railroads where the railroads themselves are using them to replace spurs, which are usually a source of expense and difficulty. Also in intercity shipments large truck companies operate transportation service for merchandise, supplies, etc. An idea of the extent of this form of transportation which is calling for better roads and the best motor trucks is given by the example of a transportation company of New York operating a motor truck transportation system within a radius of 400 miles of New York city. It has a fleet of over forty $7\frac{1}{2}$-ton trucks. It has closely connected its service with the Erie Barge Canal which runs from Buffalo on Lake Erie across the State of New York, joining the Hudson River at Troy, a distance of 387 miles. The company has linked its eight large warehouses, with a storage capacity of 900,000 square feet, and its motor truck service with the terminals of the canal in New York city and important upstate transshipment points along the canal. The Harlem river ship canal is eight miles long. The contractors unload freight direct from the canal barges at their warehouse alongside their yard for shipment by their fleet of motor trucks and delivery direct to consignees or to warehouses to be held for future delivery to New England, New Jersey, Delaware, Pennsylvania, or other seaboard states or to trans-Atlantic piers in New York city.

These motor truck transport systems are claimed to be the outcome of the inability of the railroads to handle the great quantities of freight which have congested railway traffic in all parts of the country. This condition is responsible for the discovery of the real value of the motor truck as a transportation medium. Motor trucks were used in connecting the broken lines of railroad shipping and are replacing the use of local freight trains on "short hauls" to a considerable extent, thereby releasing freight cars for the more essential shipments on longer hauls.

Shipping freight by motor trucks means less handling, less damage and safer delivery. It eliminates at least five handlings of goods as shipped by railroad: First—from factory or warehouse to freight station; second—loading from freight station

(Continued on page 527)

A train of large trucks engaged in long-distance hauling

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

The Competition in Poison Gas

THE kind of competition to which we have become accustomed between projectiles and armor also exists between gas defense and offense. In both these branches of modern warfare American scientists have distinguished themselves.

In gas defense, America matched her skill against the best brains of Germany and Austria devoted to devising gases that could not be stopped and although the major portion of our work had to be conducted thousands of miles away from the scene of action, we were successful in providing protection nearly 100 per cent perfect for our troops. Much has been published on the various phases of that problem and a great many monographs are yet to be written on the scientific and technical details.

Research in offense was equally successful and although America was inexperienced and began on the problem comparatively late in the day, she was well in the lead at the close of active hostilities not only in quantity production of deadly gases but in new developments and surprises about to be sprung. One of these new gases has been described as a super-poison gas and had properties sufficiently wonderful without the necessity of thinking up others with which to embellish a popular story.

The success of a gas attack depends in a great measure on surprise elements one of the most important of which is the use of a new gas against which the enemy has inadequate protection or a gas similar to those already in use but capable of producing either higher concentrations of toxic vapor or much more toxic conditions per unit, which amounts to the same thing. Now the latest American gas, produced in commercial quantities although not used at the front, was a great many more times as toxic as mustard gas and belonged to the same general class of poison gas. For example in order to produce the destruction of tissue, mustard gas, in reality a thick liquid, had to come into contact with the skin. This was brought about when a man walked through grass where the gas was present in small drops or otherwise became exposed to it. With the newer gas, variously known as methyl and G-43 the same sort of effect was produced by traces of vapor in the air and as it was considerably more volatile than mustard it is quite evident that as a toxic agent it was greatly superior.

So far as is known officially our enemies were unprepared to meet this gas and even if they did have a special absorbent in their gas mask cannisters designed to take out this new poison present in unusually high concentrations, they would still find protection of the body against the vapors a very difficult matter. We have reason to believe that American scientists developed superior skill in gas warfare which should be a comforting thought in view of the possibility that in another war gas will be the important weapon.

The Stimulation of Research

FOR some time this page has called the reader's attention to a few of the things scientific research has been able to do toward the establishment of our civilization and it seems proper at this time to discuss a comparatively new plan for the promotion of research. This plan, evolved by a small group of earnest scientists here, has had its initial trial under the hard conditions imposed by war, has been expanded to be international in scope, and work under the plan is being arranged upon a permanent basis. We refer to the National Research Council.

In 1863 the National Academy of Sciences was organized in the midst of our Civil War. The leading representatives in various fields of scientific endeavor, to the number of 50, were brought together by congressional charter and they gave whatever aid they could toward the solution of the many scientific problems which confronted the military establishment. That charter stipulates that "the Academy shall, whenever called upon by any department of the government, investigate, examine, experiment and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States."

On numerous occasions the Academy has served in such a capacity and in April, 1916, offered the President its services in organizing the scientific resources of the country. In accepting the offer the Academy was requested to secure the coöperation of all agencies, governmental, educational and industrial in which research facilities were available. The organization required to execute this commission was composed of the chiefs of technical bureaus of the Army and Navy, the heads of government bureaus engaged in research, men from educational institutions, from research foundations, from industrial laboratories and various engineers and consultants. To this organization was given the designation "The National Research Council" and it also served as the Department of Science and Research of the Council of National Defense. The formation of the National Research Council was in itself an indication of what splendid coöperation could be had, for the Academy is a small body of men to which some 15 may be added yearly while the council became a large organization calling in whoever, because of special training and experience, seemed likely to be able to assist.

The purpose of the National Research Council is to stimulate scientific and industrial research and to secure full coöperation in such research without any interference with independent effort and original work. In its membership will be found represented all the great national societies, many regional organizations, and individuals for all sections of the country chosen on their merits for the work in hand.

What was done during the war to justify the existence of the Council and its perpetuation? The Council and its Divisions simply tried to get things done and while no laboratories are maintained there are numbers of instances where its members carried on important work to successful conclusion in their own laboratories or joined forces with others having unusual facilities at hand. The Council had a hand as originator, advisor and helper in many instances where it would not claim credit for what was accomplished; but a few examples may illustrate the types of problems met.

To minimize the duplication of effort it was important during the war to know what was being done by our Allies on the same problems as were engaging the attention of our own researchers. To this end scientists were attached to the American embassies in London, Paris and Rome, where they performed valuable service. Early in the war the submarine problem and the development of anti-submarine devices engaged the attention of the Council and 50 of the country's most able engineers and physicists were called together to learn what had been done and to divide their number into special groups to deal with various phases of the problem. The scientists sent here by our Allies

described their work and their plans for the future to conferences arranged by the Council and intensive work began at four points. Eventually the personnel included several hundred men and wonderful results were accomplished. Some of the devices developed give promise of becoming invaluable in navigation, enabling safe sailing in fog; accurate determination of approach to reefs, land and other ships; and the location of sunken vessels.

The Division of Physics, Mathematics, Astronomy and Geophysics dealt with 70 major problems. It determined, for example, the pressures and velocities, internal and external, due to the discharge of large guns. Accurate data were obtained regarding the pressure waves about guns of different caliber and curves plotted indicating the zones in which our own men would be comparatively safe from shell shock. These pressures ran up to nearly 400 pounds per square inch at certain points and the value of the plottings is evident.

Assistance was also given on range-finding problems which grow in complexity as the range of modern artillery constantly increases. Targets are often beyond the horizon, today where in the Spanish War the scales on range-finders ran up to little more than 6,000 yards. Decided improvements were made in optical range-finders and other methods of range-finding, while the sound-ranging service by which the enemy's guns could be so accurately located was initiated by the Council and widely used by the Engineer Corps.

The Chemistry and Chemical Technology Division had 40 problems assigned to it. The Division acted as a sort of clearing house and strove to bring together the problem, the best man for its solution and the laboratory affording the best equipment to meet requirements. Some of these problems could be handled in one or more of the industrial and academic laboratories already established while others required such resources as only the government could command and a Chemical Warfare Service organization. New apparatus had to be invented to meet special needs, unusual organic chemicals had to be made and specialties such as anti-dimming materials for glass were demanded. This division afforded advice and was instrumental in bringing the best the country had to bear in all such matters. For example, it may be recalled that early in the war serious trouble was experienced with primers. No thorough going study of primers had even been made along physical-chemical lines, so investigations were started, the purpose being to work out tests and specifications so definite that maximum efficiency could be assured. This was accomplished and proved of utmost value. Incidentally, the time between the pulling of the trigger and when the bullet leaves the gun barrel is one ten-thousandth of a second.

Then there were such questions as charcoal for gas masks, detection of small percentages of poison gases, the toxicology of gases, fuels for motors, and difficult problems in ceramics and refractories. Fixation of atmospheric nitrogen called for a special committee which conducted extensive investigations into all phases of the nitrate situation and was of material aid to the government in connection with the great Alabama plants of which more will be said at another time. The explosives committee made a certain remarkable long distance star shell a success through the perfection of a proper ignition system, while new syntheses in the manufacture of new drugs reduced the cost 70 per cent.

In a war of engineering that division of the Council was, of course, deeply engaged. It had 14 committees at work and maintained closest coöperation with the great engineering societies representing mining, mechanics, electricity, illumination, automotive, testing and civil engineering as well as the Engineering Foundation. Its work was divided under such headings as metallurgy, mechanical engineering, electrical engineering and prime movers. The problems were diverse and numerous. A list would include increase of power of aero engines at high altitudes when oxygen becomes more and more rare, carburetors, the measurements of high temperatures such as steel baths in furnaces and optical glass in pots, electric welding of ships' parts, new types of guns and of helmets, the fatigue of metals and so on.

The work of the Division of Agriculture and related sciences was principally that of increased production, conservation and coöperation. The chairman spent half his time with the food administration. Activities extended all the way from fertilizer and stock feeding studies for increasing our production of foods, to the extermination of rodents as one way to keep farm products after harvest.

Never before has geology and geography played so important a part in war, even though much of its work was educational. Manuals were prepared on topography, meteorology, military, geology and the like. Further, a special study of road-building materials was made with reference to coast defenses in order that an adequate system of military roads could have been built from Maine to Florida. This information was used later in relation to the building of concrete ships.

And so the record continues through important work on the part of medicine and related sciences, where the coöperation of 12 national societies was secured; psychology which developed tests whereby 1,600,000 of our troops were rated in an effort properly to distribute our brain power and human material; work for the Federal Trade Commission and assistance on the licensing problem in connection with enemy patents; and the Patent Committee which is continuing its effort to suggest improvements in our patent system.

In two years the usefulness of the Council, created as a war service body, had been so conclusively demonstrated that on May 11th, 1918, the President issued an executive order requesting the National Academy of Sciences to perpetuate the National Research Council and outlined its duties under six main headings. Since the Council should be fully understood, both by those whose coöperation it seeks and those who will materially benefit from this coöperative work, we quote the following paragraphs from the order dealing with the work to be carried on:

"1. In general, to stimulate research in the mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare.

"2. To survey the larger possiblities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

"3. To promote coöperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all coöperative undertakings to give encouragement to individual initiative, as fundamentally important to the advancement of science.

"4. To serve as a means of bringing American and foreign investigators into active coöperation with the scientific and technical services of the War and Navy Departments and with those of the civil branches of the government.

"5. To direct the attention of scientific and technical investigators to the present importance of military and industrial problems in connection with the war, and to aid in the solution of these problems by organizing specific researches.

"6. To gather and collate scientific and technical information at home and abroad, in coöperation with governmental and other agencies and to render such

information available to duly accredited persons."

The peace program of the Council is being undertaken under the same general plan of organization as its war work was done so creditably—that is by divisions made up of government representatives appointed by the President upon their nomination by the president of the Academy, men from the industries and those from our educational institutions, all members serving for a limited time.

The Rockefeller Foundation has already requested the Council to submit a plan for the stimulation of research in universities and colleges and their suggestions for National Research Fellowships was accepted. Five hundred thousand dollars has been set aside to be expended in five years for fellowships whereby it is hoped exceptional men who are about to receive their doctorates or have just taken their doctor of philosophy degree may continue their researches at the time when they are prepared to work most efficiently and become confirmed in research. About 30 applications have been considered and six fellowships awarded thus far. Three of these are in chemistry and the others in physics. The administration of these fellowships is in the hands of the Fellowship Board of the Council and it is confidently expected that through the hearty coöperation of the institutions chosen by the fellows great things will be accomplished for science, our educational institutions, the researchers and our country.

Something has also been accomplished by the Division of State Relations and a new Division of Industrial Relations will endeavor to promote a wider appreciation of the value of industrial research to the manufacturer and to secure the organization of research laboratories by the industries. By the scheme of rotating officers and members the Council will not only enjoy the benefit of new view points and experiences but the men returning to other work will become points of contact through which much good will result. The Hon. Elihu Root at the initial meeting of the Advisory Committee on Industrial Research of the National Research Council pointed out that " . . . when the war is over the international competitions of peace will be resumed. No treaties or leagues can prevent that, and it is not desirable that they should, for no nation can afford to be without the stimulus of competition.

"In that race the same power of science which has so amazingly increased the production capacity of mankind during the past century will be applied again, and the prizes of industrial and commercial leadership will fall to the nation which organizes its scientific forces most effectively."

The Pioneer of the Trans-Atlantic Liner

(Continued from page 503)

Before she reached Kinsale, Ireland, the "Savannah's" log-book contains this illuminating item: "2 A. M. calm. No cole to git up steam." Land was sighted on the 16th of June and the next day, from Cape Clear, the vessel was reported as a ship on fire, and a naval cutter, the "Kite," was dispatched to her relief. It was then, undoubtedly, that Captain Rogers was using up the last of his pitch-pine to raise steam, and the dense smoke issuing from the craft's funnel gave her the appearance of a burning boat. After a stop for fuel and other supplies at Kinsale, the "Savannah" ran on to Liverpool, and came to anchor in the Mersey off that city in the evening of the 20th of June.

Her arrival at Liverpool was chronicled in this enthusiastic fashion: "Among the arrivals yesterday at this port we were particularly gratified and astonished by the novel sight of a fine steamship, which came round at 7½ P. M. without the assistance of a single sheet, in a style which displayed the power and advantage of the application of steam to vessels of the largest size, being 350 tons burden."

After a somewhat protracted stay at the English port, the "Savannah" went on to Denmark, Sweden, and St. Petersburg, finally leaving Europe for home by way of Arendal, Norway. During her cruise northward to Scandinavia and Russia, the ship was under steam for 239 hours, twice using her engines continuously for 52 hours. She occasioned amazement wherever she touched. In November she started back for Savannah, and reached her home port after a rather tempestuous run. In fact, the sea was too rough for her to use her paddle-wheels, and they were not put overboard until she passed in by Tybee and steamed thence up the river to Savannah.

Agreeably to his promise to President Monroe, Mr. Scarborough ordered the "Savannah" to Washington in December of 1819, hoping to dispose of her to the government. Failing to do this, her steam plant, which had cost $3,501, was removed in January of 1820 and sold for $1,600, and the craft was operated from thence on, until she was wrecked in 1822, as a sailing-packet between New York and Savannah. Her entire cost originally was $50,000.

Although the "Savannah" did not make the whole distance from Savannah to Ireland under steam, her performance heartened others and undoubtedly hastened the day of the trans-Atlantic liner. Regular steam service between Europe and the United States was not, however, inaugurated until 1838. Then the British steamers "Sirius" of 700 tons and the "Great Western," of 1,321 tons, reached New York within a few hours of one another in the latter half of April. The "Sirius" crossed in 17 days and the "Great Western" made the trip in two days less. The "Sirius" had engines of 320 horse-power while the machinery of the "Great Western" was of 750-horse-power. The "Great Western" averaged 8.2 miles an hour and consumed 655 tons of coal on her westward voyage. The total weight of her engines, boiler and water was 480 tons. These figures only serve to emphasize the extraordinary nature of the exploit of the "Savannah" and the courage of the people who stood by her. Despite the fact that she did not achieve all that was expected of her she did, nevertheless, demonstrate that it would be practicable to build a craft that could travel under steam across the broad Atlantic.

The Future of the Archaeologist in Mesopotamia

(Continued from page 506)

country. That is the reason why the great modern museums of America possess so few of the many art treasures from Babylonia and Assyria, and those few have been smuggled through the Turkish custom house. That too is why in our museums most of the objects are but reproductions of the originals found long ago. That also explains why in this country where is little popular interest in things ancient, and why it is generally believed that all things worth discovering have already been discovered.

It may be truly said that excavation work among the ruins of the Babylonian and Assyrian cities has hardly begun. Nineveh, Nimrud, Assur and the ruins of two or three other smaller Assyrian cities have been partially explored. Farther south excavations have been made at Babylon, Nippur, Bismya and Tello. Not yet has a single Mesopotamian ruin been thoroughly explored, and there are hundreds and even thousands of them waiting to give up their treasures. The entire valley from Bagdad southward almost to the Persian Gulf is a vast cemetery of buried cities. Mounds, like tombstones, mark the places where they lie. Some of the mounds are so low that they are scarcely perceptible above the level of the plain; others rise to the height of 150 feet. The oldest of them cover the cities of the Sumerians and Babylonians. Others come from the Persian, Parthian or early Arabic times. In them are buried treasures,

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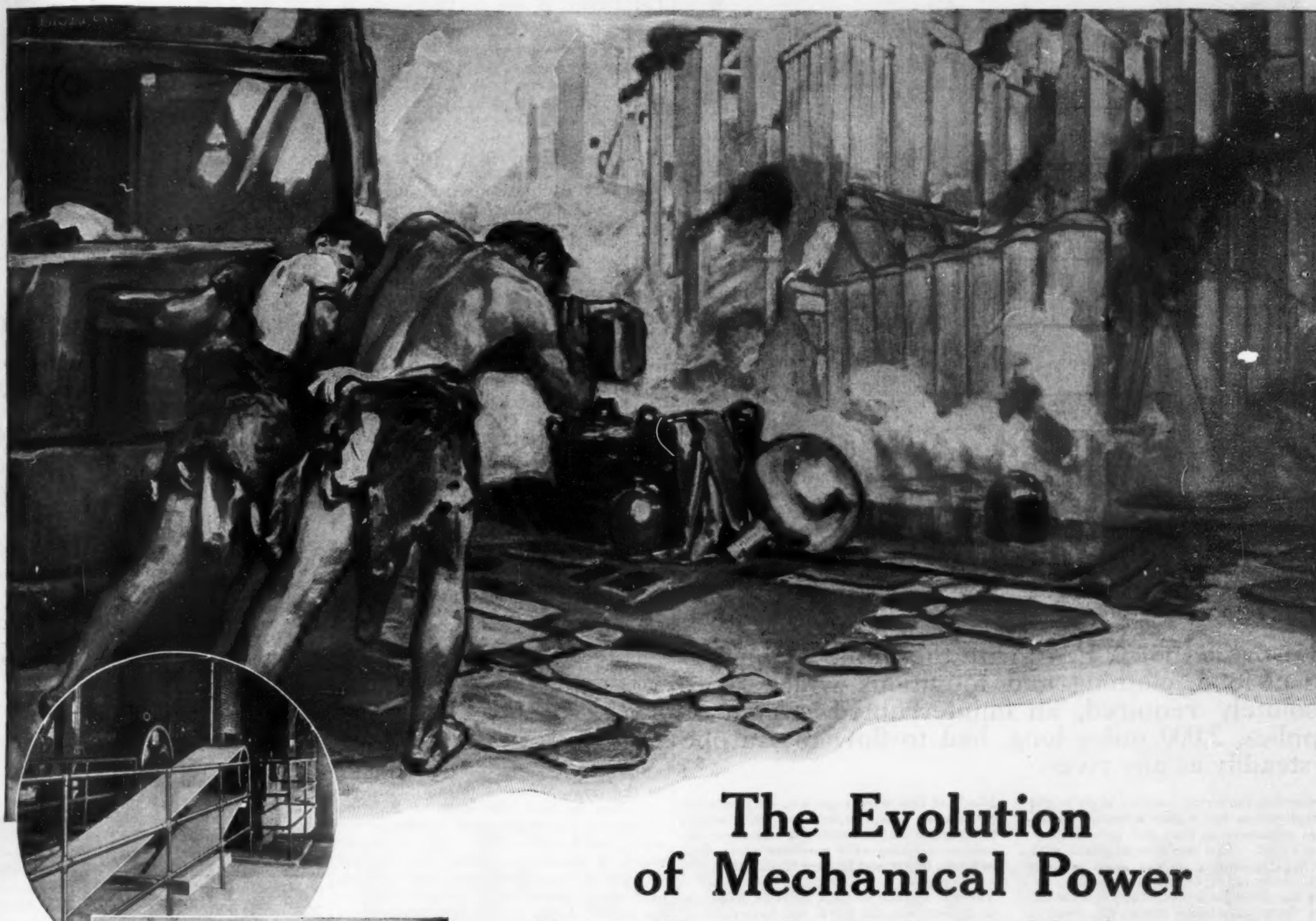

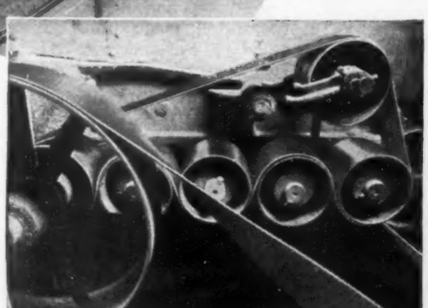

The Future of the Archaeologist in Mesopotamia

(*Continued from page 520*)

so many and so great that the museums of the whole world could not contain them all. Even in the level plain ancient objects are found whenever the natives dig for water or plow the land, and where none would think of seeking. A Tigris River boatman reached out his oar to push his boat from the shore toward which the current was carrying him. Suddenly he saw a stream of gold flow down to the water's edge. He had hit an earthern pot in which someone a thousand or more years ago had buried his wealth. De Sarcec, the French Consular Agent at Busreh, went shooting along the shore of an ancient canal. On the summit of a low unpromising mound, Tello, he saw a large stone statue of an ancient Babylonian king. Later beneath the surface he found a dozen other similar statues, which are now in the Louvre. For this discovery he was raised from the rank of consular agent to that of an ambassador, and was granted a large fortune by the French government. Near the Arab encampment of Ibra is a small mound called Drehem. Once I visited it and decided that it could be nothing but the ruin of a mud fort guarding the canal. A little later the Arabs of the vicinity discovered in that mound several hundred thousand inscribed clay tablets which were written about 2250 B. C. This is the source of many of the small clay tablets in the museums throughout America. At the outbreak of the war some Arabs south of Babylon were digging for bricks in a mound so small and low that the explorer thought it unworthy of notice. In it they discovered more than 20 large clay cylinders, each inscribed with about 140 lines of fine writing by the great Nebuchadnezzar. There he tells how he built the walls of Babylon which were one of the seven wonders of the world, and how he restored the old temple which is sometimes called the Biblical "Tower of Babel." Once while walking over a low mound near Kut-el-Amara on the Tigris I found ancient Parthian copper coins so thickly scattered on the surface that I could not step without treading upon them. They were corroded and worthless, but they indicated what may some day be found down in the protecting clay of that mound. The work of the archaeologist in Mesopotamia has hardly begun—and centuries will pass before it can be completed.

At last the Turkish Empire is breaking up. At least Mesopotamia has been wrested from the obstructive Turks, and this wonderful archaeological field promises to be opened to the explorer. When the British took control of Egypt a new impetus was given to the study of the ancient civilization along the Nile. Instead of obstructing the work of the excavator, they encouraged him in every possible way. Scholars were invited to Egypt, and anyone with the necessary qualifications and means has been permitted to dig wherever he would. In Cairo was constructed a great museum where the scholars from all the world may study every detail of ancient Egyptian life. The Egyptian government has been exceedingly liberal with the excavator, permitting him to take from the country all duplicate objects, or whatever was not desired for the Cairo museum. Thus Egyptian antiquities now form a part of the collection of every museum, and the interest in things Egyptian has become widespread.

What has taken place in Egypt will also take place in Babylonia. Already steps have been taken to promote the explorations of the ruins. An American school of archaeology has been projected for Bagdad. Several expeditions are in formation to go to the most promising of the buried cities. Probably in Bagdad will be erected a great museum where the most valuable of the treasures will be stored and made accessible. The illicit digging by the Arabs will cease, for the traffic in antiquities and the smuggling of them from the country will no longer be possible. The excavator will be allowed a part of his discoveries for his home museum. From the Babylonian and Assyrian records so far discovered we have but faint glimpses of what may yet be found.

Another obstacle in the way of Babylonian exploration work has been the difficulty in reaching the country. No inhabited part of the world has been more inaccessible. The long journey overland from Damascus to Bagdad required nearly a month of the hardest desert travel. The longer way by water from Bombay up the Persian Gulf and the Tigris was so very expensive in both time and money that the tourist never ventured that way. Now Bagdad is all but connected with the Mediterranean by rail, and the journey once requiring a month may be made in less than 48 hours.

Still another obstacle has been the hostility of the native desert tribes. All that will soon pass. The explorer who ventured into the interior, even when guarded by Turkish soldiers, took his life in his hands. Sometimes he had to fight his way or buy his safety with gifts. The expedition to Nippur was broken up by the shooting of an Arab horse thief. The German work at Fara was closed when an Arab workman was killed. Nearly every expedition has cost human life. Now a railroad has been built along the Tigris; other lines will reach into the interior. The desert along the rivers has been irrigated and converted to farms. The face of the European, which many a Mesopotamiain Arab had never seen before the war, will be familiar. The native distrust will disappear and the desert will be safe.

The methods of excavation will probably change as European influence spreads over the valley. In the past the work has been carried on in a most primitive manner. The men have been ignorant of any kind of labor. Their tools were crude and of local make. The American pick is too heavy for the Arab to handle. The shovel is a mysterious and complicated instrument, and nothing is more amusing than to watch an Arab in his vain efforts to guide a wheelbarrow. The men work in gangs of nine. The head of the gang is armed with a small one-armed pick, almost a toy, with which he loosens the dirt. With him two men with short-handled triangular hoes scrape the dirt into the baskets, and the other six men, with the baskets of dirt on their hips, slowly dance and sing their way to the dump. The future excavator will adopt more modern methods. The Arabs will be trained for their work. They will use modern implements, and the dirt will be taken to the dump by rail.

A generation ago the study of archaeology was hardly regarded seriously. To delve among the ruins of the past seeemd to most people a useless thing to do. The archaeologist was a fossil as old and as dry as the things he would discover. The archaeologist of today is a scientist trained for years by the study of languages, history and art. He is a practical man for he must lead expeditions to dangerous lands and deal with savage tribes. He is no longer the fossil he may once have been. He must have the gift to touch the things long dead, and to make live again the long forgotten civilizations of the remote past. Mesopotamia once more may be developed to feed all the world with grain. No less valuable will be the archaeological discoveries made possible by the British possession of the valley.

Mobilizing a Lady Bug Army to Fight the Aphis

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and the thousands of acres of grain infested with aphids last season, the task before the beneficial forms and the numbers of them required become apparent."

In cool weather, as has been said, the lady bugs are comparatively inactive.

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Mobilizing a Lady Bug Army to Fight the Aphis

(*Continued from page 522*)

Reproducing from eggs, they need warm temperatures to develop. The aphis is under no such restrictions. To quote this same authority further:

"During the late autumn sexed forms of aphids occur and eggs are produced. These eggs hatch in the first warm days of spring. The aphids hatching from these eggs mature in about 12 days and are termed 'stem' mothers. They are wingless and have the unusual ability of giving birth to living young without sexual intercourse. They reproduce at the rate of one to seven young per day, the progeny maturing in about 10 days and in their turn giving birth to living young at a similar rate. All the forms occurring during the spring and summer months are these agamic females, capable of producing living young. No true sex forms occur. After a few generations in the spring, both winged and wingless forms occur. The winged forms frequently fly to new fields and set up colonies there.

"In early summer most aphids occupy an 'alternation-of-heat' plant. Migratory winged forms occur and fly to some new host, often entirely unlike the spring host plant. For example, the prune aphis flies to the hop and constitutes the destructive hop aphis. This habit affords protection from their natural enemies. Where colonies are about to be wiped out these migratory forms may set up new colonies in situations where the enemy is absent. About 14 to 16 generations occur during the season. 'Fall migrants' occur in late autumn. These return to the host plant, the species occupied in the spring. Here true sexes are produced and eggs deposited."

From this it may be seen that the men in charge of the lady bug experiment are facing difficulties of considerable magnitude. These difficulties are increased by the fact that when artificially handled there is considerable mortality among the bugs, estimated as high as from 20 to 40 per cent. In spite of this it is hoped that artificial control will prove effective, particularly in the drier climate of eastern Oregon and eastern Washington. Experiments along the same line are being conducted in California by the Horticultural Commission of that state in conjunction with the Bureau of Entomology, and with gratifying results, it is reported.

The experiments that are being made both in California and Washington will be watched with interest by scientists and by farmers who are anxiously awaiting any means of destroying this serious menace to their crops.

A "Super-Charged" Airplane Engine

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proportionately to the air density. The blower comes into operation at a low altitude, and gains speed gradually, until it is operating under full load conditions, at approximately 20,000 feet altitude. The power of the engine, which would be lost through change in atmospheric density, is thereby recovered.

It is interesting to compare the results achieved with this device as against the results without it. The engineers supply the following significant figures:

The engine shown in the illustration on page 512 weighs 480 pounds, and is rated at 210 horse-power at sea-level. At 20,000 feet altitude, this engine normally develops about 100 horse-power. The engine with the super-charge blower weighs 530 pounds and develops 210 horse-power at sea-level. At 20,000 feet altitude, however, the horse-power remains the same, namely, 210.

The Liberty engine develops approximately 400 horse-power at sea-level and weighs 860 pounds. At 20,000 feet, the horse-power developed is less than 200. With the super-charge blower, the weight becomes 910 pounds, and the horse-power at 20,000 feet is maintained at 400.

The superiority of the first engine over the second at 20,000 feet is remarkable and should be noted. The smaller engine develops only one-half the power of the larger at sea-level, but, equipped with the super-charge fan, it develops slightly more power at 20,000 feet. Moreover, the difference in weight is 330 pounds, in favor of the smaller engine. At this altitude the weight per horse-power is 2.5 pounds for the smaller engine and 4.3 pounds for the Liberty engine.

It was a coincidence that within the last few weeks, an item appeared in the newspapers announcing the development in Paris of a similar device, which has been designed by the eminent French engineer, Rateau, so well known for his work in the turbine field. Detailed technical description of this device has not been published, and such information as we have been able to acquire has been gleaned from an illustrated article, which appeared in one of the Paris newspapers.

While there are fundamental differences between the American and Rateau supercharge blowers, the functions of the two are the same, and the general application to the engine of both devices has been accomplished in a somewhat similar manner.

The essential difference between the American and Rateau super-charge blowers appears to be in the method of drive. The American blower is driven mechanically, whereas the Rateau blower is operated by a turbine actuated by the exhaust gases of the engine. From available information, it would seem that the Rateau blower is generally similar to the American blower, consisting of a fan, operating at approximately 30,000 revolutions per minute; the method of mounting and connection to the carburetor is also very similar.

The exhaust turbine drive has received serious study on this side of the water by various engineers, but as yet, the difficulties have not been successfully overcome. The back pressure, which the exhaust turbine imposes on the engine, results in a serious loss of power and economy, and moreover, causes the engine to heat up with resulting valve and piston trouble of the most serious nature. The terrific heat is also very destructive to the turbine.

The development of a successful supercharge blower opens up enormous possibilities in the aircraft field, and it would seem that the future holds much in store for the successful application of such a device to all military and high speed airplanes, designed to operate at high altitudes. The theoretical possibilities of high speed at high altitudes are almost unlimited. In fact, the human element is the only factor that would seem to constrain progress in this direction. It is probable that the development of the super-charge idea will be applied to the human occupants of the plane as well as to the engine, and imagination pictures airplanes of the future proceeding through the upper strata of the atmosphere, 30,000 to 40,000 feet above the earth, at speeds of from 300 to 500 miles per hour.

Pulling the Trigger by Fluid Pressure

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This gear was turned over to a naval lieutenant who made a number of improvements, the finished product being known as the Scarff gear. The idea once in hand, numerous mechanical gears were brought out, but all were handicapped by one great drawback which it seemed impossible to overcome. The timing was a delicate operation, and the adjustments necessarily fine. The mechanical gear, constructed of metal parts, could be timed perfectly on the ground, but the intense cold of the higher altitudes caused the metal to contract, and the timing would be thrown out of adjustment. Furthermore, the very active friction of the working parts caused severe wear, and so tended to nullify the accuracy of operation.

The problem came to the attention of M. Constantinesco, a Rumanian by birth,

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Pulling the Trigger by Fluid Pressure

(Continued from page 524)

naturalized in England, and he applied to it a principle in which he had just become greatly interested—namely, the transmission of power through a column of fluid. Because he encountered this principle while experimenting with sound waves under water he named it the "sonic" principle. He emphasizes that it is not as though the fluid were a rigid column, and imparted shock in the same way that a sledge imparts the blow of a hammer to a bar upon which it is held by a second workman. There is actually generated, by an impact upon one end of the column, pressure wave, which traverses the column at the rate of 4,900 feet per second, delivering a blow at the other end, not instantaneously, but after the lapse of the infinitesimal interval called for by this velocity and the length of the tube. It was doubtless their failure to appreciate that the outfit did not constitute a rigid system that kept the Germans from learning how to operate it—for its advantages are so marked that had they been able to unravel the secret, they would surely have used it.

M. Constantinesco's apparatus consists essentially, as our drawing shows, of a copper pipe filled with oil, at one end of which is a piston and at the other a push-rod to operate the trigger. The piston is connected with the propeller shaft by a gear and a cam. At the proper instant in each rotation of the propeller, the hump on the cam drives the piston down upon the end of the oil column, which is under a pressure of 150 pounds. Through this compressed column the shock of the piston blow travels as a pressure wave; and when it reaches the other end it operates the firing mechanism. The rotation of the propeller generates 40 to 60 of these wave impulses per second, with no friction except the very slight amount to be found between the gear and the cam.

It is, of course, not desired that the gun begin firing the moment the pilot takes the air, and continue until he makes his landing and stops his engine. So some means of control must be provided, and this is made possible by the necessity of having the oil column under pressure before it will transmit an effective blow. A small chamber is provided, connected with the copper pipe, and normally the oil occupies partly this chamber and partly the pipe. When it is desired to set the gun going, the pilot throws a small lever connected with his joy-stick, and this, with the aid of the spring shown in the reservoir, expels the oil from the reservoir, forces it out into the pipe, and puts it under pressure there. Then things begin to happen in the oil column, and the gun begins to speak.

Selling Woodworking Machinery Abroad

(Continued from page 514)

"France is not likely to buy very much American woodworking machinery because of the activity of French manufacturers. A much better opportunity exists in Spain, where there is a decided preference for American machinery, earned by the high quality of that imported from the United States. We expect spirited competition from the British and French firms, however, and from several factories in the Barcelona district. Italy offers a most attractive market. The use of woodworking machinery in Lombardy is extensive, the furniture, vehicle and building-material industries being well developed. Before the war, 70 per cent of the imports were supplied by Germany. Our agent was told that one German firm gave some of its customers three or four years to pay for their purchases in easy installments. We have decided to appoint a general Italian agent at Milan to handle our business."

Brazil's Increasing Importance

With the development of its railroads and sufficient immigration to increase adequately its supply of labor, Brazil should become one of the world's principal

LEGAL NOTICES

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sources of lumber for building and industrial purposes. Rio de Janeiro and Sao Paulo are now the great woodworking centers of the country. The prospective American exporter should consider three important features affecting the adaptation of American machines to Brazilian conditions. With the exception of Parana pine, most woods in Brazil are much harder than those sawn in the United States; comparatively low-powered steam engines are used in most plants; and the labor employed is not highly skilled. Most mills in Sao Paulo cut only joists and lumber for general construction purposes, usually having in addition planers and machines for preparing moldings and floor and ceiling material. Carpenters do as much work as they can in their own shops, and not in the building in which they are working. Their shops are usually equipped with at least one band-saw, a planer and an upright molding and variety planer. Wood lathes are used in furniture factories, carpenter shops and shoe-last factories.

The United States is the leader in the machinery market of Australia, and its sales of woodworking equipment have been developed chiefly in this way. A sample machine is sent to the agent or importer, who is allowed a substantial extra discount on introductory orders. Actual demonstration has usually created an immediate demand for American machines. The exclusive agency is accepted as the most satisfactory method for selling machinery and accessories in Australia. If proper care is taken in the selection of a progressive house, there is little fear that such an arrangement will be used to stifle competition, reliable firms being as anxious to develop business as manufacturers.

Long Distance Motor Transportation

(Continued from page 516)

or truck to cars; third—unloading at destination from cars to trucks or freight station; fourth—unloading from trucks to stores, factories or warehouses; and fifth—handling in case the goods are removed from the car to freight station and held until the consignee sends a motor truck to remove them.

Distances considered practical for motor truck transportation are held by various authorities to average from 100 to 300 miles. In special instances trips of 400 miles have been made. The establishing of long distance motor truck service during the emergency of the war is undoubtedly the forerunner of a continuation of such service on an even larger scale in the era of peace. The service is demonstrating to manufacturers and merchants that motor truck transportation is the only way to escape delays caused by slow moving local railroad freight trains and the loss of time that had frequently been experienced even before the railroad freight congestion became so acute.

When counterbalanced by their capacity and more extended distance of travel, the upkeep of motor trucks has proved to be less expensive than the maintenance of horses. One of the big trucks of the fleet under discussion has been in the service for four years, and it has never had its engine taken down for a general overhauling. It is still in commission carrying its rated capacity load every day. The following is a schedule of the distances and time made by one of the 7½-ton trucks.

	Miles	Hrs. Per Trip
New York to Philadelphia	100	12
New York to Baltimore	188	22
New York to Dover, Del.	172	21
New York to Waterbury, Conn.	95	11
New York to New Haven, Conn.	77	9
New York to Bridgeport, Conn.	58	8
New York to Hartford, Conn.	113	16
New York to Springfield, Mass.	159	18
New York to Worcester, Mass.	190	23

The foregoing gives a practical insight into the transportation methods of the immediate future. Motor truck transportation has come to stay. The problem now is to perfect and develop it.

The Castor Bean and Its Many Uses

The mention of castor oil provokes a reminiscent protest as a rule; it has associations which most of us would rather forget; and yet, today, it is brought home to us that this particular oil is of outstanding military value, especially as a lubricant for the engines of aircraft of all sorts.

Early in the year, the War Department and the Department of Agriculture joined forces in an energetic campaign to induce the farmers of certain sections of the United States to undertake the cultivation of quite 100,000 acres of castor bean plants, and, as a consequence of this patriotic appeal to our tillers of the soil, 108,000 acres were actually sown. The urge to this action was the need of something like 5,000,000 gallons of castor oil for the nation's fighting flying machines.

Extensive experiments carried on by the Allies and later undertaken by the Bureau of Aircraft Production of the War Department, proved conclusively that castor oil was the lubricant par excellence for fast-running motors for aerial service. Up to a point, various blends of mineral and vegetable oils did well enough, but none of these was found capable of answering the supreme tests of sustained flight under a wide range of temperature and varied atmospheric conditions. Nature, somehow, had endowed the castor oil with characteristics that were singularly and strikingly united, as if the wants of mechanical flight had been curiously anticipated.

Why, it may be asked, are the needs of the aircraft motor any different from other high-speed engines? Strictly speaking, the requirements are not essentially dissimilar so long as the airplane travels close to the ground and there contends with much the same conditions as the prime movers of a racing automobile. But the moment the flying machine mounts skyward the physical circumstances under which it operates are radically altered. The atmosphere, in the course of a few minutes, may change from a temperate to a very frigid temperature, and, not only that, but the barometric pressure is lowered directly, materially affecting the propulsive power of the gaseous explosions within the cylinders.

Again, in order to get a maximum of driving energy with a minimum of weight, the designer of the aircraft motor has had recourse to aluminum pistons functioning within cylinders of special alloy steel. Therefore, in order to protect the much softer aluminum from the abrasive action of the neighboring walls of steel, and yet to insure a snug enough fit to prevent the premature escape of the expanding gases, it is imperative that the two metals be continually separated by a film of oil. Not only that, but the lubricant must not be thinned out by the intense heat of the combustion within the cylinders, it must retain its "body," hold its place, and yet possess anti-frictional properties of a high order. Likewise, the oil must not carbonize or foul when exposed to the explosive flame. Finally, the lubricant must maintain its fluidity even when exposed to the effects of intense cold, for otherwise it would fail to flow from the reservoir on to the pump and thence through the various pipes to the points or moving parts to be constantly oiled.

If the flying machine could stop or return to earth in safety whenever the engines balked or the oiling system went wrong, probably numerous other lubricants might do well enough. But the airplane, particularly the military craft, must be able to stay aloft for hours and hours, and to travel above enemy territory with a reasonable chance of escaping destruction or capture because of engine breakdown. Continuous service for a hundred hours is demanded of the motor before mechanical overhauling of a material degree is necessary. To achieve this mobility it is indispensible that the lubricant be of the very best and susceptible of standing up to its work no matter what may be the weather or the position of the mercury in the thermometer. Nothing else meets these manifold conditions but castor oil.

Castor oil, so it is said, has the highest specific gravity of any natural fatty oil, and is unrivalled in its viscosity, *i. e.*, "body," by any other known natural fatty oil. Not only is it singularly unresponsive to high temperatures, but it flows freely until it freezes at a temperature between 15 and 20 degrees Fahrenheit below zero. Further, the oil keeps remarkably well even after an exposure of several years to the atmosphere. These are the physical reasons for the choice of castor oil as a lubricant for the engines of aircraft.

Popularly, this use of the oil seems like a sudden discovery and the diverting of the material into new channels of service—previous employment, as the average layman understands it, being mainly limited to medication. As a matter of fact, castor oil as a lubricant has been doing its helpful bit for a good many years in various parts of the world, and has been doing its work well, at that. Further, the industrial arts have drawn upon it latterly to a generous extent, but don't let us anticipate the story we have to tell. Until about 1900, and previously for quite four decades, castor beans were raised in considerable quantities in parts of Oklahoma, Kansas, Missouri and Illinois, and earlier still the plants were grown to some extent in Virginia, North and South Carolina, Georgia, Kentucky, Texas and California. In the days of the domestic plenty of the castor beans they were utilized in the making of oil both for lubrication and for medicine, but the industry dwindled rapidly after 1900 when our farmers found they could raise other crops that paid them better and mineral lubricants and competing castor beans from India emphasized the wisdom of this course on the part of our husbandmen.

In India, the castor bean has flourished naturally for untold years and has been cultivated assiduously for a number of decades. Just how many bushels of castor beans are harvested annually in India is not recorded, nor are her exports of castor beans and oil an index of the measure of the industry, simply because the people of India use enormous quantities of the oil for domestic services. However, there are some suggestive figures available. When the various countries of Europe began to realize prior to the war the value of castor oil as an airplane lubricant, the demands upon India increased steadily. During 1913 and 1914 preceding the outbreak of strife, Germany doubled her previous imports of both castor beans and castor oil from India, and between 1914 and 1915 the Indian exports of the oil amounted to nearly 900,000 gallons, while during the interval between 1916 and 1917 she shipped away about 1,725,000 gallons. During the present year, Great Britain commandeered the entire exportable supply of India's castor oil and castor beans, in order that she and her Allies might have the fullest possible measure of the lubricant for their aerial squadrons.

It was this situation, with the prospect of a very large air fleet of our own, that impelled the U. S. Federal authorities to urge the extensive cultivation of castor beans in this country. To help us in this venture, Great Britain released for seed purposes a matter of substantially 6,330 long tons of Indian beans. The Department of Agriculture painted rather a promising picture for the encouragement of domestic growers, and announced, in effect, that the farmers might expect to harvest anywhere from fifteen to forty bushels of beans per acre, and the Government guaranteed first $3.50 a bushel and then, some months later, raised the price to $4.50 a bushel. It is unfortunately a fact that the foreign seed, seasonal handicaps, and possibly the general newness of the undertaking have operated against the hoped for results, and, taking the industry here, by and large, an average yield of only five bushels to the acre has been achieved. This does not augur well for the future if

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The Castor Bean and Its Many Uses

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our farmers within the United States are to compete with growers in the tropical and semi-tropical regions where two or three harvests are possible in the course of a year.

Even though the ce sation of war modify the urgency of a great supply of castor oil, it is undeniable that the commercial and pleasure uses of the flying machine, together with the military aircraft that we shall surely have to have, will call year by year for increasing amounts of this lubricant. And whether or not it will be worth while for our native growers to continue in the business will depend, in the main, upon the amplified uses that can be found or developed for castor oil and the by-products of its manufacture.

According to the grade or strain of the beans, they contain anywhere from 46 per cent to 53 per cent of oil; and of this 33 per cent is commonly yielded by the first expression. This is a cold process, and the oil so obtained is that which is devoted to pharmacy and to the high-grade lubricant called for by the flying machine as well as the racing automobile. Subsequent expression gives 7 per cent of addition oil, and it is possible to increase the total yield by treating the oil cake with a suitable solvent. It is the belief of some of the manufacturers that much of the second-grade oil would answer even for airplane service.

And now, what are some of the uses to which castor oil, apart from that of a lubricant for air craft, is put or may be turned? Ordinarily, we require here yearly about 1,000,000 bushels of castor beans, and only 25 per cent of the oil extracted, if quite that much, is consumed in the various departments of pharmacy. The other fields of employment are much more extensive than most of us realize. For instance, castor oil figures to a large extent in the manufacture of substitute or artificial leather, which takes the place of natural leather in the upholstering. Castor oil is an essential component in some artificial rubbers, and there are various kinds of celluloid which depend upon this product of the castor bean. Castor oil furnishes a very satisfactory coloring for butter; and from castor oil is produced the so-called "Turkey-red oil," which is an important factor in the dyeing of textiles and in the treatment of the fabrics. One of its largest uses is in the making of transparent soaps. Castor oil yields sebacic acid which is superior to stearic acid in the manufacture of candles, and from it is also obtained caprylic acid which lends itself to the composition of varnishes peculiarly suited to the polishing of all kinds of high-class furniture, carriage bodies, and paintings, and is extensively employed in the preparation of vellum, tracing cloth, etc. Caprylic acid plays a part in the production of ethers which are used by perfumers and confectioners. Castor oil is used in the making of certain waterproof preparations, and a liquid disinfectant is obtained from the "seconds" or lower grade oil. The oil is an admirable preservative for various kinds of leathers, is extensively used in the leather industry, and is particularly serviceable in adding to the service life of leather belting employed in heavy work. Our fly papers would not be so effective if it were not for castor oil, and the oil enters into the get-up of a great many adhesive agents.

In the sugar mills of the West Indies, upon the railroads of India and other parts of the Far East, and in British shipping circles castor oil has long been used as a mechanical lubricant, afloat, however, it is generally blended. In India the oil has been found to be an economical and superior illuminant—giving a markedly brilliant flame. Indeed, the peoples of India have found ways to utilize the oil and the refuse pomace which may suggest other services here in the future. The pomace contains from 6 to 7 per cent of of nitrogen and a measurable amount of potash; and it is authoritatively said that the castor-seed cake possesses 2.81 per cent of phosphates. It is, therefore, easy to understand why the stuff makes an excellent fertilizer. In India, too, gas is obtained from a low-grade of castor oil, and is widely used for lighting. Finally, it has been found practicable to produce this gas from the seed cake after the oil has been extracted for other purposes. Notwithstanding the pretty general belief that the castor bean plant will not be touched by cattle, it is stated as a fact by competent authorities that the leaves, not the stalks are widely fed to cows in India, and an added yield of milk is attributed to this forage. In Assam, the foliage of the castor bean is cultivated largely for the purpose of feeding silk worms; and an excellent paper pulp can be made from the plant.

The Theory of Electro Culture

By Robert D. McCreery

IF we believe in the ionic theory of Electrolytic Dissociation" we are convinced of the fact that when an electric current is driven through an electrolyte there is produced a movement of the "ions" that carry charges of electricity.

In the use of direct current the negative ions move to the positive electrode and the positively charged ions move to the negative electrode. When alternating current is used this is not the case; the ions move rapidly first in one direction towards one electrode, then in the opposite direction towards the other. They are as it were in a state of intense vibration of an oscillating nature, caused by, and in unison with, the waves of the alternating current.

What then happens if we discharge high frequency electricity through an acre of soil to metallically coated seed, from electrodes (parallel to each other), embedded in the earth?

The earth is in this case the electrolyte, in which, by the action of water, there have been gaseous ions set free. When the electricity is applied, these ions set up an active bombardment on the seeds and tiny roots of the plantlet and since the seeds and roots are porous it must be evident from a mechanical standpoint that some absorption, by the plant, of the gaseous ions takes place. After being absorbed by the plant roots these ions are still subject to the influence of the high frequency electricity which, during application, will set up vibrations within the cells of the plant. Such an action will mechanically enlarge the cells in the tissues of the plant and allow it to grow more freely.

The discharge of high frequency electricity through soil is also equivalent to aeration since it causes air to be drawn into the soil with it. This is in a great measure the principal benefit derived from cultivation and is, therefore, an important factor in agriculture because of its stimulation of bacterial action.

Moreover the discharge of high frequency electricity through the air combines with the moisture in the soil to produce nitric acid, which contains nitrogen in a form readily available as plant food.

On the other hand the electronic collisions of the ions with alkalies in the earth produce nitrites. The earth in a sense becomes a storage of nitrogen that must be changed by the soil bacteria before it becomes available as plant food. This makes work for the soil-building bacteria.

In 1909, Prof. G. E. Stone of the Massachusetts State Agricultural College, proved in a series of tests that by discharging each day a few sparks of static electricity through soil containing bacteria, these organisms in 17 days increased 600 per cent.

There is another influence of electricity on the bacteria which might be termed bacterial stimulation. Bacteria are sluggish micro-organisms and the galvanic action of the current on their bodies increases their activity.

With the above proven facts in mind, is it at all surprising that enormous increases in production have been reported where electricity has been properly applied to this new art of promoting the growth of vegetation?

NEW BOOKS, ETC.

A COURSE IN WOOD TURNING. By Archie S. Milton and Otto K. Wohlers. Milwaukee: The Bruce Publishing Company, 1919. 8vo.; 339 pp.; illustrated.

The course, based on problems given to high school pupils, provides instruction in the use of tools, with careful expositions of spindle turning and face-plate turning. The lessons are well-ordered and progressive, aiming at the gradual development of confidence in the pupil, while suggesting harmonious lines in design. The problems, to each of which a full-page drawing is devoted, run from tool-handles to chess men, and utilize all kinds of cuts.

NOTES ON THE STOWAGE OF SHIPS. By Chas. H. Hillcoat, Master Mariner. New York (45 Warren Street): Colonial Publishing Company, 1918. 8vo.; 237 pp.; folding cargo plans.

Officers of the merchant marine will appreciate the utility of this third, revised edition dealing with the stowage of cargoes, with weights and measurements, and including extracts from the British Board of Trade Regulations giving requirements for the carriage of cattle, grain, explosives, and dangerous goods. Folding inserts show cargo plans of the "Scotia" and "Nubia." The items of cargo are in alphabetical order, so that information is readily found.

ESSENTIALS OF ALTERNATING CURRENTS. By W. H. Timbie and H. H. Higbie. New York: John Wiley and Sons, Inc., 1919. 8vo.; 374 pp.; 223 figures.

The educational equipment of workers on alternating-current appliances is often restricted to the grammar school curriculum, and the authors of this new and decidedly helpful text have kept such limitations strictly in mind. In simple language, avoiding the use of algebra and trigonometry, it presents such essentials of laws and practice as the competent worker must know, with the problems of every-day experience. It is based on the knowledge acquired in years of teaching by short, intensive methods, and is as well adapted to trade, industrial and technical schools as it is to individual study.

THE MARVELS OF PHOTOGRAPHY. By Charles R. Gibson, F.R.S.E. Philadelphia and London: J. B. Lippincott Company, 1919. 8vo.; 222 pp.; 30 illustrations.

While this is a popular account, with the avowed purpose of bringing the romance of the subject home to the amateur and general reader, there is much that may be fresh to the ordinary professional. The inventions and discoveries of the art are readably narrated, and color photography is presented with plates illustrating the three-color process. Mentionable chapters are those treating of photography and the criminal, the photography of the invisible, and how microbes are made to sit for their portraits. The preface refers to an appendix of valuable data, but we find no such appendix in the copy in hand. The work is made up of excerpts from a larger volume, "The Romance of Modern Photography."

STEAM ENGINE TROUBLES. By H. Hamkens, M.E. New York: The Norman W. Henley Publishing Co., 1919. 8vo.; 284 pp.; illustrated.

An expert designer and superintendent of erection here places the engineer under a debt of gratitude by providing him with information that will enable him to avoid or surmount the many troubles encountered; the purchaser is ably guided in his selection, for the design and construction of the various parts are so presented as to differentiate good from bad practice, thus forestalling costly and dangerous accidents. The work discusses advantages and disadvantages of design, the troubles peculiar to each, proper foundations, erection, and operation, including lubrication, trouble location, and adjustments. Lavish illustrations show the features and assemblage of all important parts, from cylinders and valves to hook rods and dashpots.

LIQUID STEEL. Its Manufacture and Cost. By David Carnegie, F.R.S.E., assisted by Sidney C. Gladwyn, Wh.Ex., A.M. Inst. C.E. New York: Longmans, Green and Company, 1918. 8vo.; 526 pp.; illustrated.

Too little is taught metallurgical and engineering students of the supreme importance of costs. Here we have a systematic comparison of all the steel-making processes; this should be welcomed by manufacturers, managers, chemists, and many others connected with steel works equipment and control. The author arranges in tabular form, for easy reference, the analyses and costs of iron ores, pig irons, refractory materials, fluxes, ferro alloys and fuels; he treats of the composition of charges for different classes of steel, with particulars of the finishing additions required; he gives details of the construction, arrangement and cost of furnaces and plant; and he presents methods of assembling steel works' costs and details concerning the value of labor and the costs of living in various industrial countries. The value of a work of this scope is at once apparent, and it introduces considerations that should be part of every metallurgical course.

THE ELEMENTS OF ASTRONOMY. By Charles A. Young, Ph.D., LL.D. New York: Ginn and Company, 1919. 12mo.; 508 pp.; illustrated, with maps.

It is assumed that the student has mastered the subjects that naturally precede astronomy, including elementary algebra and geometry. To those thus equipped this deservedly popular text, in its revised form, offers an excellent introduction to the fundamentals of the science. An appendix treats of the determination of solar and stellar parallax, describes astronomical instruments, gives tables, sets suggestive questions, and includes a synopsis for review and examination. A brief Uranography concludes the work.

THE INSTRUCTOR: THE MAN AND THE JOB. A Hand Book for Instructors of Industrial and Vocational Subjects. By Charles R. Allen. Philadelphia and London: J. B. Lippincott Company, 1919. 12mo.; 373 pp.

For long years hit-or-miss methods prevailed in the instruction of the unskilled worker, or the skilled worker set a new task. There is still much haphazard teaching going on in even our largest industries. This work by a highly qualified authority simplifies the whole question of industrial and trade training, with a view to the development of the competent instructor. Its tenets are in such form that they may be used either as a school text or in industrial organizations with equal benefit. Keen analysis, sound philosophy and psychology, and effective planning and execution are evident on every page; the methods have again and again demonstrated their efficiency in training unskilled labor and reducing labor turnover and overhead costs.

OUR NATIONAL FORESTS. By Richard H. Douai Boerker, M.S.F., Ph.D. New York: The Macmillan Company, 1918. 8vo.; 238 pp.; illustrated.

Our national forests, covering 155,000,000 acres and comprising enormous resources, furnish a story decidedly worth reading. Until now, this could only be found piecemeal in scores of Government publications; the author of this popular work has not only brought this information to light and arranged it logically, but by the force of his own experience has given us a book with an individuality of its own. In it will be found the latest statistics, the clearest account of how our forest resources are being disposed of and managed by the Government, and the most convincing demonstration of what the National Forest movement means in our national economy.

A CENTURY OF SCIENCE IN AMERICA. With Special Reference to the American Journal of Science, 1818-1918. By Edward Salisbury Dana and others. New Haven: Yale University Press, 1918. 8vo.; 458 pp.; illustrated.

In a dignified example of the publishing art commemorative of the hundredth anniversary of the founding of the American Journal of Science we read the history of the Journal from its foundation and follow the principal branches of science to which its pages have been devoted. The position of each branch a century ago is made plain, and its progress carefully recorded. Under geology we learn of its advance in North America, its steps in the interpretation of land forms, and the gradual growth of knowledge of earth structure with a review of Government surveys. Other papers deal with the development of vertebrate paleontology, the rise of petrology as a science, the growth of mineralogy, the work of the Geophysical Laboratory of the Carnegie Institute of Washington, chemistry, physics, zoology and botany. There are 22 portraits of the men largely responsible for our present knowledge, and each department of science is presented by a writer eminent in his field.

THE EVOLUTION OF THE EARTH AND ITS INHABITANTS. By Joseph Barrell, Charles Schuchert, Lorande Loss Woodruff, Richard Swan Lull and Ellsworth Huntington. New Haven: Yale University Press, 1918. 8vo.; 208 pp.; illustrated.

These five lectures were delivered before the Yale Chapter of the honorary scientific society of the Sigma Xi, and constitute a symposium on the geological and biological evidences for the evolution of our planet and the earth-borne life, ranging from a conception of the universe to the trend of modern civilization. The history of the earth is traced until conditions necessary to the appearance of life are established; all that is known of the origin of life is discussed; an attempt is made to discover the forces responsible for the rhythmic acceleration of evolution. Much original research is embodied in the volume, which is unique in treatment and in the ordering of its facts.

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